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Pennsylvania 6,000-Hp. Diesels 57

Aluminum in Freight-Car Construction 63

Coal-Burning Steam-Turbine Locomotives 65

Seaboard's Diesel Shop 68

Editorials:

Power from the Atom 72
Evaluating Welding Society Participation 72
Why Spend All the Money in One Place? 73
Random Notes on Magnaflux Testing 73
Permanent vs. Portable Scaffolding 74

The Reader's Page:

Load Compensating Brake and Freight-Car Weight Reduction 75
Present Status of Freight Car Weight 76

With the Car Foremen and Inspectors:

Shadowless Light 77
Oscillating Lights on Suburban Trains 77
An Intercoupling Problem 78
Metallic Steam Connection Repairs 79

In the Back Shop and Enginehouse:

Locating Eccentric Cranks 81
Locomotive Boiler Questions and Answers 82
Monon Dedicates New Diesel Repair Shop 83
Tellurium-Graphite Use in Foundry Work 83
Air Brake Questions and Answers 84
Questions and Answers on Locomotive Practice 85

Electrical Section:

A. C. Power System for Trains 86
Care and Maintenance of Railroad Storage Batteries 90
More Kw. Output from Axle-Driven Generators 93

New Devices:

Vertical Gearmotor 95
Passenger Train Sprayer for Insect Extermination 95
Quick-Change Spindle 95
Jack With Separate Pump 96
Water Softener for Use on Diesel Locomotives 96
Portable Attachments for Electric Hand Drills 96
Tap and Drill Disintegrator 97
Time Saved in Drilling Boilers 97

News 98

Index to Advertisers 144

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RAILWAY
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Pennsylvania 6,000-Hp. Diesels

Three-unit Fairbanks-Morse locomotives designed for fast freight service have top speed of 69 m.p.h. with 70:17 gear ratio and 42-in. truck wheels

AMONG the orders for Diesel-electric road power placed by the Pennsylvania during 1947 were eight 6,000-hp. road freight locomotives built by Fairbanks, Morse & Company and powered with Fairbanks-Morse 2,000 hp. opposed piston Diesel engines and General Electric generating, control and traction equipment. This group of freight locomotives consists of 16 A units and eight B units, each three-unit locomotive having a total weight in working order of 1,064,420 lb. Each unit is carried on two six-wheel trucks having two driving axles and one idling axle. The tractive force per locomotive is 221,000 lb. at 30 per cent adhesion. The locomotives have a gear ratio of 70:17 and are designed for a maximum speed of 69 miles per hour.

Location of Equipment

In the A units the operator's compartment occupies the forward end of the body. The operating cab is raised above the locomotive floor and the cab and nose of the locomotive are a welded structural shape built as a unit and welded to the body. Air brake equipment and sand boxes are located in the nose section. The control equipment is mounted in a panel box between the engine room and the operator's compartment. The engine compartment takes up the rest of the body unit with the power plant approximately in the center of the locomotive and radiators, oil coolers, air reservoirs, water tanks and sand boxes at the rear of the engine compartment. Motor driven traction motor blowers are located at the front and rear of the engine compartment above the trucks. Motor-driven radiator exhaust fans mounted in the roof at the rear of the engine compartment pull air in through louvers in the side of the body through the radiators and out through the roof. The louvers are automatically controlled. Battery boxes, fuel tanks and additional air reservoirs are suspended from the underframe between the trucks.

The location of equipment in B units is the same as in the A unit except that at the forward end of the unit the space ordinarily taken up by the operator's cab is unoccupied except for hostler's control brake equipment and sand boxes.

Underframe and Body

The entire locomotive body unit construction is designed to the requirements of A.A.R. standards for new passenger car equipment. The underframe is a welded structure of steel plates and shapes and the center sills run the full length of the platform under the deck-plate. Flooring consists of steel plates welded to the underframe members upon which non-skid flooring is applied in the engine room passageway areas. The cab sides are of truss construction and are welded to underframe cross members. The engine room side walls are metal-sheathed plywood mounted on the outside of the cab side truss. Roof sheets are welded directly to the framing. Hatch covers simplify removal of equipment.

General Characteristics and Dimensions of Pennsylvania 6,000-Hp. Diesel-Electric Freight Locomotive

Horsepower: Net to traction motors	6,000
Weight (in working order), lb.:	
A unit	355,160
B unit	354,100
Total locomotive	1,064,420
Per driving axle (4 per unit), avg.	61,400
Per idle axle (2 per unit), avg.	54,600
Principal dimensions, ft.-in.:	
Width overall	10- 6½
Height overall	15- 3
Length inside coupler knuckles	64-10
Truck wheel base	15- 6
Total wheel base	51-11
Min. radius of curvature (loco. only), ft. (21 deg.)	275
Wheel diameter, in.	42
Tractive force, lb.:	
Continuous	123,000
At 30 per cent adhesion	221,000
Maximum permissible speed, m.p.h.	69
Speed at continuous rating, m.p.h.	15.5
Supplies (per cab unit)	
Fuel oil, gal.	1,650
Lubricating oil, gal.	360
Engine cooling water, gal.	490
Sand, cu. ft.	20

Diesel Engine

Each unit is powered by one Fairbanks-Morse vertical ten-cylinder, two-cycle, single-acting, opposed-piston type engine having a rating of 2,000 hp. at 850 r.p.m. for traction purposes.* The cylinders are 8⅛-in. bore by 10-in. stroke with two pistons per cylinder. The pistons operate in water-jacketed cylinder liners having exhaust ports at the bottom and intake ports at the top. Scavenging is on the uniflow principle, there being no valves or heads.

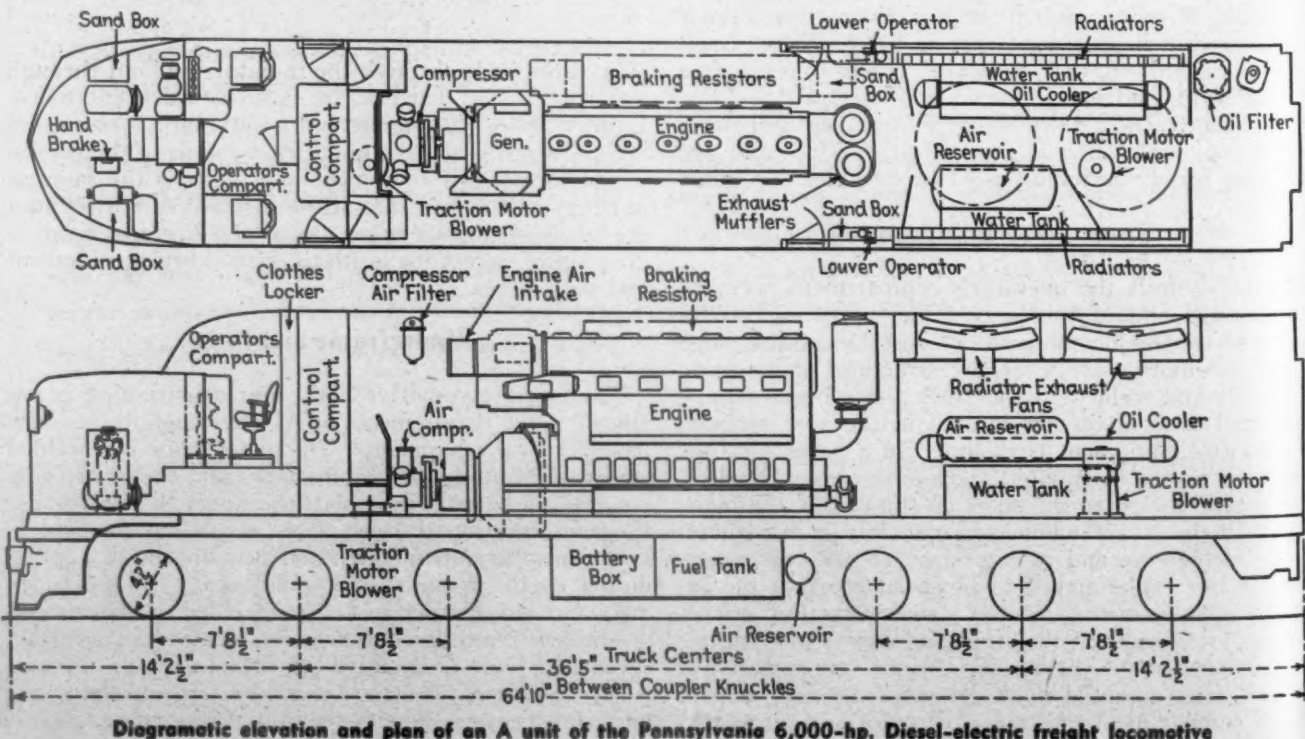
This type engine has an upper and lower crank shaft designed to transmit the power produced in the cylinders through vertical drive gears and crank shaft couplings. A thrust bearing is used next to the vertical drive gears and plain main bearings are located at each transverse cylinder block member. The crank shafts are made of chrome-nickel-molybdenum cast iron with precision machined surfaces for main and connecting rod bearings.

At one end of the upper crank shaft is the drive for a positive displacement type scavenging blower which furnishes air to the cylinders under a pressure of from three to six pounds per square inch. Scavenging air from the blower is contained in air reservoir compartments extending the entire width of the cylinder block and completely surrounding the cylinder liners at the air inlet ports.

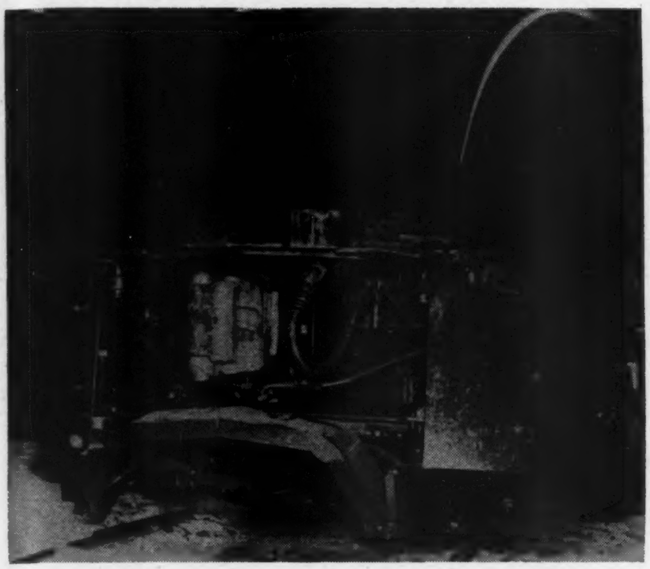
The vertical shaft connecting the upper and lower crank shafts consists of upper and lower pinion shafts with a flexible coupling between them. The pinion shafts are mounted in roller bearings and supported by thrust bearings. The vertical shaft incorporates provision for timing the upper crank shaft with respect to the lower crank shaft.

The pistons have three basic functions: (1) to act as movable gas and compression tight closures for the cylinder and to transmit power to the connecting rods and crank shafts; (2) to function as valves for the admission of scavenging air and the exhaust of combustion gases and (3) to form combustion space between recessed heads as they approach dead center. The design of the upper and lower piston and rod assemblies are similar except that the lower connecting rod is longer than the upper one. Upper and lower pistons are identical with oil cooled piston heads having a smooth cylindrical outer surface unbroken by any cross-bore for the piston pin. This is accomplished by the use of a piston insert into which the pin is fitted. This insert is secured to the piston head and shims are used to adjust the clearance between the two pistons. The piston pin insert acts as an inner oil jacket wall. The oil is discharged from the piston into the crank case without additional piping. Each piston is fitted with compression and oil-control rings and both pistons are easily removed from the lower end of the cylinder through crank case openings. The connecting rods and bearing caps are drop forged and the rods are drilled lengthwise to transmit cooling oil and piston pin lubricant from the crank shaft pin. The piston pin bearing a bronze-lined steel bushing pressed into the connecting rod end and the bearings at the crank shaft end are bronze-backed shells lined with bearing metal and assembled without shims.

*A detailed description of the Fairbanks-Morse opposed-piston engine appeared in the October, 1944, Railway Mechanical Engineer, page 439.



Diagrammatic elevation and plan of an A unit of the Pennsylvania 6,000-hp. Diesel-electric freight locomotive



The pilot coupler is designed so that there are no openings when coupler is retracted

The fuel supply system for the engine consists of a service tank, supply pump on the engine, strainers, filters and gages. The fuel supply pump is driven by a d.c. motor which also drives a 400-cycle alternator and governor oil pumps. This pump draws fuel from the service tank, delivers it through a waste-packed strainer-filter to a header in which a pressure of about 15 lb. per sq. in. is maintained. The injection pumps, two to each cylinder, are mounted vertically under a camshaft. They are of the constant stroke, single valve, rotating plunger type. Fuel is metered by a helix machined on the pump plunger and the relation of this helix to a port in the pump barrel. The angular position of the helix is changed by a rack and pinion connected to the governor. The injection nozzles are of the spring-loaded differential type with a built-in fuel filter. The nozzles are bolted to an adapter in the cylinder wall permitting easy removal. Each nozzle is connected to its injection pump by short pieces of high-pressure tubing all of equal length.

The engine is equipped with pressure lubrications and piston cooling. The lubrication system consists of a gear pump, two oil headers built into the cylinder block, an oil sump tank, a strainer, cooler, filters, thermometers and necessary piping. The lubricating oil pump is mounted on the control end of the engine and driven by the lower crank shaft. The pump draws oil from the sump below the engine and forces it successively through strainers and coolers, lower and upper headers then through supply pipes to main bearings, crank pin bearing, connecting rod passages, piston pin bearings and piston oil cooling jackets.

There are two separate cooling systems in connection with the engine, one for cooling the jacket water and one for cooling the lurbicating oil. The jacket water is cooled by means of radiators and the lubricating oil system by means of heat exchangers which in turn are water cooled and the heat dissipated in another set of radiators. The circulation in each of these cooling systems is effected by separate centrifugal pumps driven directly from the engine. One of these pumps circulates water through the engine cylinder jackets and radiator system and the other circulates water through the heat exchangers and their radiator system. The engine radiators dissipate engine heat by air drawn into the engine compartment through thermostatically controlled louvers and out through roof fan chambers.

Electrical Equipment

A General Electric shunt wound commutating pole type GT-567 generator is directly connected to the engine crankshaft through a flexible coupling of the multiple disk type. The commutator end has a spherical roller type anti-friction bearing which takes end thrusts of the armature.

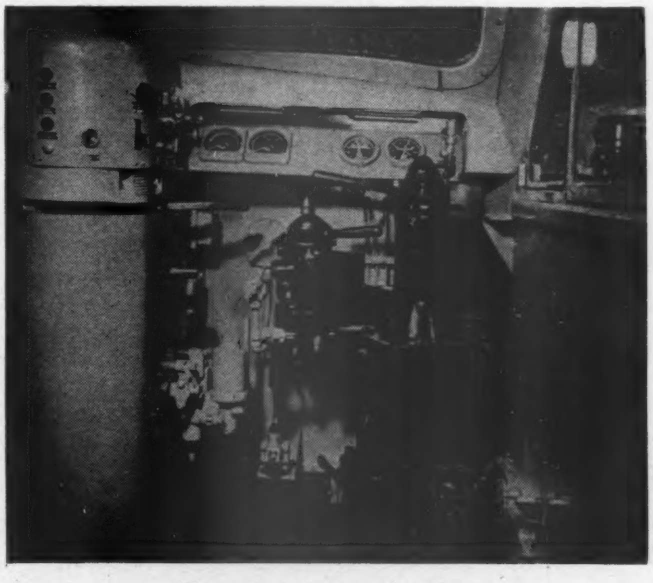
The generator is self-ventilated by a fan at the coupling end. A discharge duct is provided to discharge heated air outside of the cab and a damper is located in the discharge duct to permit the re-circulation of air through the engine room in cold weather.

Four General Electric d.c., series wound, commutating pole, forced ventilated type GE-746 traction motors are mounted on the driving axles. Motor armature bearings are of the anti-friction type.

One auxiliary generator, gear-driven from a shaft extension of the main generator, furnishes power for battery charging, controls and lighting. The voltage is regulated to maintain constant voltage over the full range of engine speeds.

A second gear-driven variable voltage auxiliary generator supplies power for the two radiator fan motors and two traction motor blowers.

A General Electric amplidyne exciter, gear-driven



The operator's control station

from the main generator shaft provides controlled excitation to the main generator.

A ground relay protects the power circuit in case of a ground.

Auxiliary circuit controls are of the magnetic type and operate independently of main power circuit. Wheel slip relays function to indicate when the wheels on any unit slip.

A motor cutout switch permits cutting out any one motor. With any motor cut out, engine power is automatically reduced to maintain normal horsepower input per motor on the motors remaining in the circuit, thus permitting normal speed at reduced tractive force.

A 32-cell lead-acid type storage battery is located in a compartment below underframe between the trucks. Cranking of the engine is accomplished by motoring the main generator through use of a starting winding energized by the storage battery.

Protective devices include two lubricating oil pressure switches which shut the engine down in the event that oil pressure is too low for operation in: (a) power

notches *5* to *8*; (b) idling to power notch *4*. Two temperature switches are provided, one for engine jacket water and the other for lubricating oil which reduces engine loading and speed in the event of excessive temperatures.

Amplidyne Excitation System

Current for the excitation of the main generator field is supplied by an amplidyne exciter. The special feature of the amplidyne is extremely rapid response to changes in its own excitation. Field current of the amplidyne exciter is controlled by a static regulator which automatically regulates amplidyne and hence main generator excitation to provide optimum locomotive performance without exceeding the operating limitations of the electric apparatus.

The limitations which must be observed are maximum traction generator load current and maximum traction generator field current. Generator load current is limited to prevent overheating and excessive sparking and to provide controlled tractive force. Field current is limited to prevent overheating of the generator shunt field and to limit generator voltage.

The static regulator for the amplidyne exciter uses 400 cycle a.c. saturable core reactors as control elements. Measures of generator load current and generator field current are compared to signals which determine generator line current and field current limits. Both the current measures and limit signals are fed in through d.c. bias windings on the saturable core reactors. The 400-cycle power is used because it permits the use of relatively small reactors and provides for rapid response of control functions.

In addition to protecting the generator from too

Dynamic braking curve

much armature current, the current limit also serves to control low-speed tractive force. On the first throttle notch, the current limit is reduced to allow just about enough current to move the locomotive. As the throttle handle is pulled back, the current limit is raised a little on each notch, permitting smooth starting of the train. Full generator current is allowed only at the highest notch.

Locomotive Control

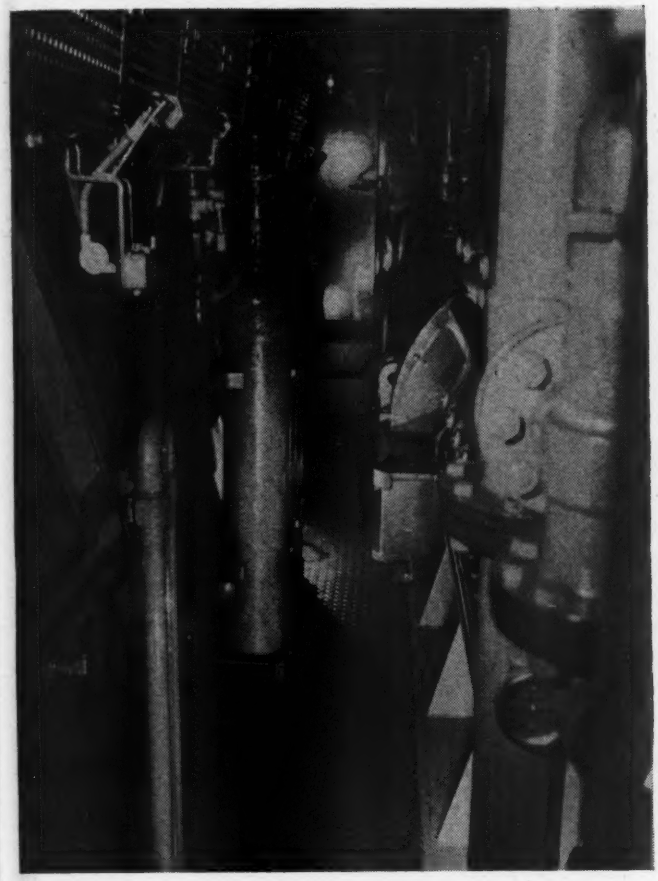
The locomotive control allows the operator to select any one of eight engine speeds, and functions automatically to load the engine to its capacity at each of these speeds and at all locomotive speeds within permissible limits of generator armature and field current. It also serves to control wheel slipping and provides for dynamic braking and automatic transition, forward from series-parallel to parallel motor connections and backward from parallel to series-parallel. The two major divisions of the control are a power plant regulating system, and an amplidyne excitation system for the main traction generator. Electric power for operating controls is obtained from the 64-volt control battery and a 400-cycle, 115-volt, motor-driven alternator. Hydraulic power for operation of the governor hydraulic cylinders is obtained from a motor-driven pump which supplies oil at 125 lb. per sq. in.

The power plant regulating system is a hydro-electric system making use of an electric speed measuring, speed setting and stabilizing system which controls a hydraulic servo-mechanism with sufficient power to operate the engine fuel racks. A small a.c. generator measures engine speed. The associated electric circuits compare this speed signal with the speed setting of the system and operate a "pilot" control valve in the hydraulic servo-mechanism which in turn operates the engine fuel racks through motion of the slave power piston. To simplify multiple-unit operation, the position of the master controller (throttle handle position) is translated to all engine controls by four train wires and four speed setting control relays at each engine.

Engine speed is regulated by either fuel or load adjustment. Regulation is accomplished by adjusting the fuel flow up to the "fuel limit" for the engine speed. (The system includes a variable fuel limit which automatically adjusts to the maximum permissible fuel rate for optimum engine performance and life at any given speed setting.) For all operating conditions where the separately excited tranction generator tends to load the engine beyond the power available at the preset speed and "fuel limit," the governing system controls the generator excitation to match the generator demand to the engine ability. (A control rheostat operated by the hydro-electric servo-mechanism controls the amplidyne exciter to regulate load demand.)

Partial List of Materials and Equipment on the Pennsylvania 6,000-Hp. Diesel-Electric Freight Locomotive

Back-up light	Electric Service Co., Cincinnati, Ohio
Batteries	Gould Storage Battery Corp., Depew, N.Y.
Brake, Hand	National Brake Co., New York
Brake shoes	American Brake Shoe Co., New York
Brakes, Air, air compressors	Westinghouse Air Brake Co., Wilmerdink, Pa.
Cab signal	Union Switch & Signal Co., Swissvale, Pa.
Cooler, Lubricating oil	Ross Heater & Manufacturing Co., Buffalo, N.Y.
Couplers, draft gear	National Malleable & Steel Castings Co., Cleveland, Ohio
Coupling, Flexible	Falk Corporation, Milwaukee, Wis.
Electrical equipment, fans and blowers	General Electric Co., Schenectady, N.Y.
Engine, Diesel	Fairbanks, Morse & Co., Chicago
Filter, Air	Farr Co., Los Angeles, Calif.
Filter, Fuel	Purolator Products, Inc., Newark, N.J.
Filter, Lubricating oil	Michiana Products Corp., Michigan City, Ind.
Fire extinguishing system	C-O-Two Fire Equipment Co., Newark, N. J.
Gauges, Pressure	U. S. Gauge Div. of American Machine & Metals, Inc.
Headlight	Pyle-National Co., Chicago
Heaters, Cab	Kysor Heater Co., Cadillac, Mich.
Horns, Air	Leslie Co., Lyndhurst, N.J.
Insulation (cab roof and sides)	Gustin-Bacon Mfg. Co., Kansas City, Mo.
Muffler, Engine exhaust	Burgess-Manning Co., Chicagc
Paint	E. I. du Pont de Nemours & Co., Wilmington, Del.
Power plant regulator	General Electric Co., Schenectady, N.Y.
Radiators (2)	Yates-American Machinery Co., Beloit, Wis.
(22)	Perfex Mfg. Co., Milwaukee, Wis.
Rigging, Brake	Westinghouse Air Brake Co., American Brake Div., Wilmerding, Pa.
Sanders	Prime Manufacturing Co., Milwaukee, Wis.
Shutter operating mechanism	Fairbanks, Morse & Co., Chicago
Speedometer	General Electric Co., Schenectady, N.Y.
Stand-by heater	Vapor Car Heating Co., Chicago
Train phone	Union Switch & Signal Co., Swissvale, Pa.
Trucks	General Steel Castings Corp., Eddystone, Pa.



The C-O-Two fire extinguisher equipment in the engine room

Dynamic Braking

For electric braking, the motor armatures are disconnected from the generator and are connected across braking resistors. The motor fields are connected in series and separately excited from the main generator. The motors act as generators, taking power from the drivers and converting it into electrical energy which is dissipated by the braking resistors in the form of heat.

The amount of braking is controlled by the operator by means of a braking potentiometer which is connected across the locomotive battery and operated by the controller selector handle. The generator current limit regulates the motor field current (generator output). The setting of the current limit is determined by the voltage between the potentiometer brush arm and one end of the potentiometer. Its brush arm is connected to a train line to set the same current limit in trailing units when running two or more units in multiple. The current limit holds low motor field current when the train line voltage is low and raises the motor field current when the train line voltage is raised.

The current limit circuit is rearranged for braking by means of a braking relay. The rearrangement is necessary because of the extreme range required—from zero to full motor field current—and to obtain sufficient accuracy of control to assure the same braking on all units over the full range of motor field current.

Transition

Some older types of locomotives were equipped with voltage biased relays for automatically transferring from series to parallel motor connections. These relays were not suited to handle backward transitions from parallel to series. It was up to the operator to retard the throttle handle and to drop the relay back to the lower connection.

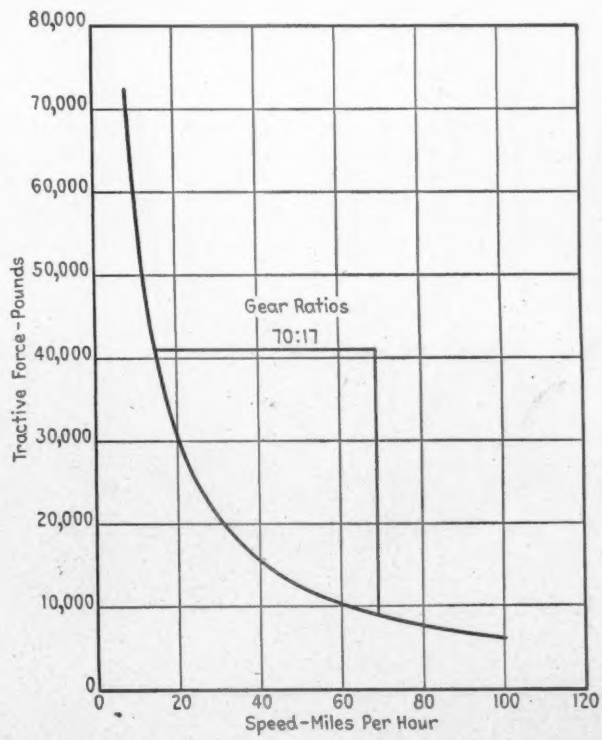
Other locomotives depended solely on manual operation of the selector handle for initiating the transitions. Results were satisfactory as long as the operator moved the handle at the correct locomotive speed. When he erred, the results in terms of shock to the train, and in the electric equipment, were most undesirable.

To provide for smooth automatic transition, both forward and backward, the locomotive is equipped with an axle generator developed to operate tuned frequency equipments. It has a permanent magnet, 14-pole rotor, with a three-phase Y-connected stator and is rated 50 volt-amperes for speeds from 15 to 120 m.p.h., with wheels from 36 to 42 in. in diameter.

For the purpose of transition, a combination of reactors and capacitors, tuned to peak sharply at the desired speed, and to maintain approximately the maximum output for frequencies above the peak value, operate a low energy relay through a rectifier. The sharpness of the curve is such that the pickup and dropout of the relay are within five per cent in terms of locomotive speed. This means that transitions from series-parallel to parallel can be set for 33 m.p.h. and the reverse at 31.5 m.p.h. The low energy relay action is relayed to the locomotive control circuits.

Fire Extinguishing System

On one side of each unit are installed a group of four 50-lb. capacity C-O-Two cylinders arranged to operate two cylinders at a time. The cylinders are connected to a common pipe leading to four hose stations. In the A units one hose station is located in the engine compartment on each side, adjacent to the doors leading to the cab, one station is located adjacent to the left side door and one is located at the rear door.



Speed-tractive force curve with 70:17 gear ratio and 42-in. wheels

The location of the equipment in the B unit is similar to that in the A unit.

The four cylinders are cross-connected so that one group acts as a reserve for the other. In addition, the

systems in each locomotive unit are connected by means of a flexible connection so that the total capacity of each unit acts as a reserve for the other.

At each hose station two remote control pull boxes are mounted, one on the inside of the unit and one on the outside near the sill so that it can be reached from the ground. The handles in the pull boxes are connected by means of flexible steel cable run in conduit to the control heads on the cylinders. The pull cables are arranged so that any two cylinders can be released from either side of the locomotive, thus eliminating the necessity for the crew to run from one side to the other in order to obtain an additional supply of carbon dioxide.

At each hose station, a normally closed quick acting direction valve is installed in the piping ahead of the flexible hose. The valve must be opened before the hose is used on a fire. Its purpose is to prevent loss of gas if the system were used while one or more of the hoses happened to be temporarily removed.

A header safety relief is installed between the valve and the flexible hose. It consists of a ½-in. plug in which are located a safety disc washer, safety disc and retainer nut. The safety disc ruptures at a pressure of approximately 2,900 lb. per sq. in. Its purpose is to relieve excessive pressure so that the hose will not rupture. This could occur if the system was not completely exhausted before the valve on the discharge horn and the direction valve were closed.

Plastic "sylph-seals" are placed over the safety disc nuts at the base of the cylinder valves and on the header safety reliefs. This provides a visible means of checking if the safety discs have been ruptured.

A squeeze-grip valve is provided on the discharge horn for controlling the flow of carbon dioxide while working around a fire.

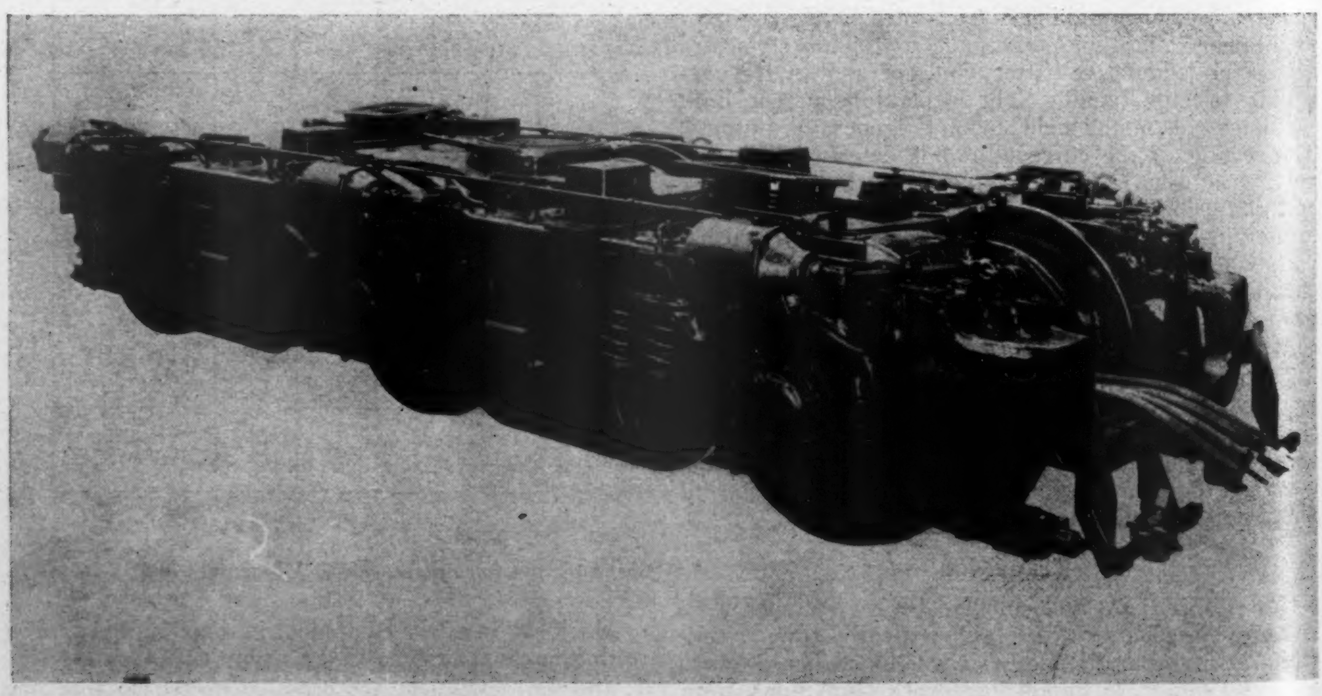
Electric thermostats are mounted over each Diesel engine and in each electrical cabinet. The thermostats are connected in parallel and then to a relay.

A red warning light is mounted on the dash in the cab. This, together with a bell, is operated by the relay which is energized by one or more of the thermostats when an excess temperature such as a fire occurs. When the temperature has dropped back to normal, the thermostats will reset and stop the alarm condition.

Trucks and Brake Equipment

Each locomotive unit has two six-wheel equalized swing-motion motor trucks having one-piece cast steel frames and bolsters furnished by the General Steel Castings Corporation. Each truck has two motors carried on the end axles, the center axle being an idler. The axle-supported motors have spring nose suspension from the truck transoms. The axles are mounted in roller bearings and above each journal box there is a rubber centering device on which the equalizer ends are supported. Lateral movement is taken through this centering device and through the rubber cushion pedestal liners attached to the integral pedestals of the truck frame. By this arrangement road shocks are cushioned and the truck passes through curves more readily. The rubber cushioned liners have hardened spring steel wearing plates. The truck frames are spring-supported on two equalizers at each side with a double nest of coil springs between the frame and each equalizer. The spring planks are carried on swing hangers suspended from the truck frame. The spring planks carry four double elliptic springs which support the swing bolster at its four corners. Side bearings are used at each of the four corners of the swing bolster. The truck is fitted with clasp brakes on all wheels and the brakes on each pair of wheels are actuated by individual brake cylinders, arranged to provide approximately 75 per cent braking power at 50 lb. cylinder pressure.

The locomotive brake schedule is 24-RL straight and automatic air brake equipment having provision for braking the unit individually or in conjunction with other units or the trailing train. Air for the locomotive brakes is supplied by a two-stage air-cooled Westinghouse compressor having two low pressure and one high pressure cylinders. The compressors, designed in operation at 140 lb. pressure, have a displacement of 262 cu. ft. per min. at 850 r.p.m. An unloader governor in conjunction with an electrical train line synchronizes the compressors in multiple unit operation.



Commonwealth six-wheel cast-steel truck

Aluminum in

Freight-Car Construction*

By Gilbert B. Hauser†

An evaluation of the economic advantages of aluminum alloys in several types of freight cars with specific data on the alloys recommended for the job

The evolution of today's freight car has been very gradual. There has been refinement of detail but few basic design changes have been made. Perhaps the reason for this is the existence of arbitrary standards which have been set up, mainly to facilitate car interchange. Unless one has the interest of a railroad which can operate a car of new and novel design, the time and effort required to produce such a design is probably wasted. As we are at present producers of construction materials only, we are limited to the fitting of our material to existing design standards. This paper does not deal with new or novel design changes. It will describe aluminum-alloy applications to freight cars, the reason therefore, and discuss briefly the economics of lightweight equipment.

Of the several classes of freight cars, the hopper car, both open and covered, offers the best medium for immediate economical weight reduction applications. Here the weight saved may be put back as increased revenue capacity which must eventually offset the higher cost of all weight-saving materials. Aluminum alloys permit a maximum increase in capacity and decrease in tare weight of the car. In addition, in open hopper-car construction they have the additional money saving virtue of longer life. They are not as vulnerable to the action of leachings from coal as are the other materials used for car construction. Data accumulated over the past fifteen years in standing and service tests with actual cars and with sattionary hoppers lead us, and others, to believe that an aluminum hopper-car body will stand up under the corrosive attack of coal, at least for its entire amortized life. With mounting labor costs, the consequent reduction of repair programs should produce material savings. In addition to increasing the capacity and lowering the tare weight of a covered hopper car, aluminum alloys will render this type of car suitable for commodities other than those now normally handled in this type of car, as for example, food products; here, as in tank-car work, a special type of car is required by the lading, regardless of car weight and, in such cases, the weight reduction is obtained as a bonus.

Tank and Refrigerator Cars

The aluminum-alloy tank car is being used today in constantly increasing numbers: There are now over 500 of these cars operating and on order. The aluminum-alloy tank is built for transporting certain specific ladings, such as acetic acid, nitric acid, acetic anhydride, formaldehyde, hydrogen peroxide, nylon salts, etc. These chemicals do not attack the aluminum to any marked degree nor are they contaminated by the aluminum. The aluminum tank car does the best job at the lowest cost. Here light weight is not a requirement but it is automatically obtained as an added advantage. Aluminum tank cars have operated on the railroads successfully for almost 20 years.

Concerning refrigerator cars, you may remember the published remarks in the Railway Age issue of March 17, 1945, by a freight traffic manager of one of the western roads, but I wish to quote herewith from those remarks: "Average light weight of a standard refrigerator car has increased about 4,000 lb. in the past twenty years, with little, if any, increase in the cubical loading capacity. With the increasing use of fans and other devices, unless some method is developed to stop this trend, there will be still further increased light weight. The importance of reducing light weight of refrigerator cars is hardly second to reducing light weight of passenger cars. Unlike other types of freight equipment, refrigerator cars are almost constantly in motion and run up great mileages through their lifetime."

The article then contains the following calculations as to the savings to be obtained by lightweight refrigerators:

Average transcontinental loaded haul	2,500 miles
Empty haul (80 per cent of loaded)	2,000 miles
Total mileage per trip	4,500 miles
Six trips annually	27,000 miles
Cost of hauling 5 non-revenue tons at one mill per ton-mile	$135 per annum
Equals 3 per cent on a	$4,500 investment

Based on these figures, the freight traffic manager then reaches the following conclusion: "As money for improved refrigerator cars can probably be obtained for less than 3 per cent, it should be quite obvious that there is a very profitable field to the carriers in increasing the initial cost to secure lighter-weight cars."

The refrigerator Car Committee of the United Fresh Fruit and Vegetable Association recommended in 1944 that new refrigerator cars be built using the lightest weight metals possible. They later embarked on an experimental program, the result of which was Illinois Central car No. 51,000. We were honored to be included in that project. Since that time several other aluminum-alloy refrigerator cars have been constructed as well as one of stainless steel.

Except for the general desire to decrease weight of all freight equipment with a consequent saving in operating expenses, the boxcar seems to offer the least favorable opportunity for economical reduction of light weight of car. Due to one of those arbitrary rules mentioned previously, all boxcars are carried on 50-ton trucks whether they are 40, 50 or 60 ft. long. With this limitation, it is often not feasible to put back into extra capacity the weight saved.

There is one good exception to this statement and that is in fast or overnight special freight service between distant points. Such service demands the ultimate in light weight so that a maximum load of freight can be hauled on the fast passenger train schedules. Fast-freight services, as we know about them today, are using standard heavy equipment and thereupon are not hauling the maximum revenue load. Perhaps in these days of car

*Paper presented before the Railroad Division, American Society of Mechanical Engineers, on December 4, 1947, at the annual meeting of the society at Atlantic City, N. J.

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Weight Comparisons of Aluminum and Other Types of Car Construction

HOPPER CARS

	Suggested all-aluminum design	Suggested design—aluminum body (steel center sill and bolster)	Low-alloy steel	Steel	Missouri-Pacific aluminum body (steel center sill and bolster)	Steel
Nominal capacity, tons	50	50	50	50	70	70
Light weight, lb.	27,700	31,500	33,500	40,000	37,000	50,100
Capacity, cu. ft.	2,370	2,370	2,273	2,145	3,000	2,733

	Covered Hoppers		Refrigerator Cars			Boxcars	
	Suggested All aluminum design	Steel	Ill. Cen.—Aluminum body and steel underframe	Pacific Fruit Express—Aluminum body and steel underframe (est.)	Steel	Aluminum body and steel-underframe	Steel
Nominal capacity, tons	70	70	40	40	40	50	50
Light weight, lb.	32,750	49,600	51,100	48,100	56,500	37,000	44,700
Capacity, cu. ft.	2,208	1,973	....	....	....	....	....
Length between bulkheads, max., ft.-in.	....	....	39-0	39-0	39-0	....	....
Length inside, ft.-in.	....	....	....	....	....	40-6	40-6

shortages a really new type of service is not to be realized. However, looking to the future it would seem that more and more special fast-freight service must come. Though air freight is but a small competitor today, it is quite logical to assume that it will increase each year and must be met by the railroads.

Aluminum Alloys for Cars

For most freight-car uses, we have standardization on Alcoa alloy 61S. It is an aluminum-magnesium silicide alloy characterized by moderately high strength and good formability. This alloy was also selected after careful consideration of its corrosion resistance under the general service conditions found in railroad operation. The magnesium-silicide alloys are more corrosion resistant than the higher-strength copper-bearing alloys. This 61S alloy in the annealed state has a typical yield strength of 8,000 lb. per sq. in. and an ultimate strength of 18,000 lb. per sq. in. In the solution-heat-treated temper, it has a yield strength of 21,000 lb. per sq. in. and an ultimate strength of 35,000 lb. per sq. in. In the fully aged condition it has a yield strength of 40,000 lb. per sq. in. and an ultimate strength of 45,000 lb. per sq. in. The symbols "W" and "T," respectively, that have been used to designate these two tempers are being changed to T4 and T6.

For rivets, our 53S-T61 alloy is generally recommended. It has a shear strength of 23,000 lb. per sq. in. This temper is for cold driving only and can be used up to ½-in. diameter when hand driven, or in almost any diameter when power driven. The same alloy rivet in the solution-heat-treated temper is recommended for hot driving work which is usually employed when hand-driving rivets over ½-in. diameter. Depending upon the heating temperatures used, shear strengths between 18,000 lb. per sq. in. and 24,000 lb. per sq. in. may be obtained. The hot 53S-W rivet is quite well suited for hand driving. When designing aluminum riveted joints it is necessary to increase the number of rivets in comparison with steel construction, because the shear strengths listed above are approximately one-half those of steel rivets.

We have been successful in adapting 61S alloy in one or more of its tempers to the manufacture of parts for hopper cars over steel designs. Certain builders of steel hopper cars have modified their designs of some of the more difficult parts so as to allow the steel to be pressed cold. Further work could be done along this same line to simplify more of these parts so that when using aluminum there would be no necessity for using annealed material which requires subsequent heat treating. A hopper car designed specifically for aluminum alloys would permit practically all parts to be pressed cold in either the solution-heat-treated or artificially aged temper (61S-T4 or T6).

Aluminum-alloy tank-car tanks are built either of riveted or welded construction and meet all required tank-car specifications. The welded tank is designed around the strength of the welded joint and meets A.A.R. Specification 201-A-35W. For this specification, Alcoa alloys 2S, 3S and 61S are generally employed; the commodity to be carried governs the choice of alloy. All welded tanks are today being welded by the argon-shielded tungsten arc process. Under the experimental I.C.C. Classification 103-AL, Alcoa alloy Alclad 14S-W (14S-T4 in the new terminology) is used in a riveted tank. We are hard at work today obtaining the data necessary to permit the writing of a specification covering an all-welded I.C.C. class of aluminum-alloy tank car, specifically for the transportation of hydrogen peroxide in concentrations above 52 per cent.

Essentially, refrigerator- and box-car designs are similar and our past experience indicates that all parts can be successfully fabricated in aluminum alloys. From a strength standpoint, we find that additional side stiffeners are required to resist the bulging load when the car is considered to be loaded with wheat. This, however, is no great problem and a substantial weight saving for these stiffeners can still be realized.

Weight Comparisons

In order to place before you some idea of the light weights which can be obtained with aluminum construction we have made a table of weights, using as comparisons some standard carbon-steel designs as well as some special low-alloy designs. Included in the aluminum weights are those estimated for a 50-ton open hopper and a 70-ton covered hopper of which we have made some suggested designs. The other aluminum weights are of cars actually built or now under construction.

Economics

Studies of the economic advantage of lightweight cars have been conducted by two different railroad groups and also by various individuals. The report of the Mechanical Advisory Committee to the Federal Co-ordinator of Transportation in 1935 gave a suggested method of evaluating light weight, with which every railroad man is familiar. Recently a committee of the Association of American Railroads also made a report of its study on the same subject. I quote from the foreword of this latter report:

"It must be assumed that ultimately the economic benefits of light weight cars will be realized by most, if not all railroads and each railroad will be benefited by cars of others as well as its own, even if not on a mathematically proportional basis."

In studying these two reports, it will be found that, though they are different in their method of analysis,

(*Continued on page 67*)

Coal-Burning

Steam-Turbine Locomotives*

By John S. Newton†

Effect of steam pressures and temperatures on total steam requirements discussed and their economic limits evaluated-Capacities of 4,000 to 5,000 hp. are considered—The data are based on 2 lb. per sq. in. exhaust pressure and draft

Several attempts have been made in this country in recent years to build an improved form of steam locomotive. Success has been achieved in varying degree, but no locomotive has yet been devised which is of sufficient advantage over modern reciprocating steam locomotives to warrant more general adoption. In all cases where the fuel has been coal, a more or less conventional fire-tube boiler has been used. It is believed that a radical departure from past boiler practice is necessary, if a better coal-burning steam locomotive is to be built. This is not

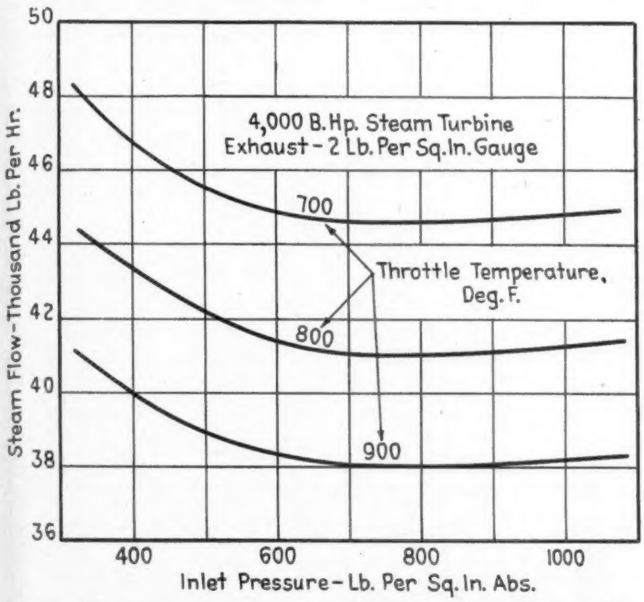


Fig. 1—Steam requirements of a 4,000-hp. locomotive turbine

because the present type of boiler is unsatisfactory, but rather because it has known limitations which preclude its use in securing desirable steam conditions for a steam locomotive of the future.

The purpose of this paper is to establish the effects of steam conditions and capacity on important elements of a steam-turbine locomotive embodying a combination of design principles proved in other applications. It is hoped that those experienced in the design of boilers and furnaces will agree that there is reasonable prospect of meeting the steam capacity, efficiency and type requirements essential to the development of such a locomotive.

During 100 years of development of the reciprocating steam locomotive, custom design in most respects has become accepted practice. This has been thought necessary because of prevailing wide differences in fuel, water, profile and operating conditions. The builders of Diesel-electric locomotives, however, have found that standardization is possible. This is due to the greater uniformity of fuel, the use of very little water and to the electric transmission. It therefore appears that in approaching a degree of standardization which has been found important, a steam locomotive should be provided with an electric transmission, or its equivalent, suitably treated water (already a practice of several railroads) and the ability to burn most coals, but not necessarily all of them.

Similarly, as trains have become longer and speeds have increased there has been demand for locomotives of increased capacity. Recent practice in steam-locomotive design has been to cram every bit of capacity into a steam locomotive that the right-of-way and turntables can accommodate, and along with this to carry as much coal and water as the design of a tender will permit. There is,

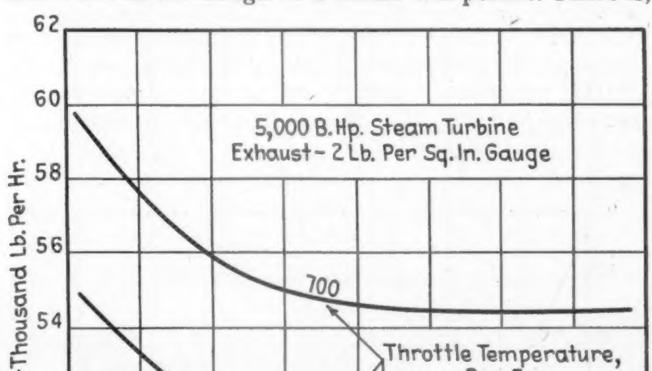


Fig. 2—Steam requirements of a 5,000-hp. locomotive turbine

of course, a purpose in so doing, but this practice is only one solution to the problem.

What Horsepower?

Examination of the purchases and use of Diesel electric locomotives discloses the fact that a large majority of our trains are being pulled by locomotives having 4,000 to 6,000 hp. in engine rating. In addition, many of these locomotives are being operated with substantially less than the rated engine capacity actually available for traction. Therefore, it would appear that a reasonably

* A paper contributed by the Railroad division at the annual meeting of the American Society of Mechanical Engineers held at Atlantic City, N. J., December 1-5, 1947.

†Assistant manager of engineering, Steam Division, Westinghouse Electric Corporation.

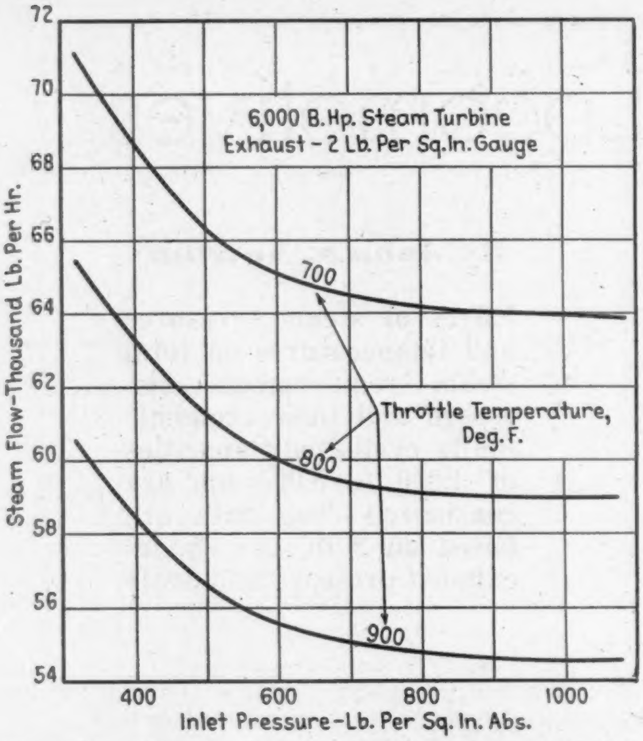


Fig. 3—Steam requirements of a 6,000-hp. locomotive turbine

universal steam locomotive might have 4,000 to 5,000 hp. available for traction. The significance of establishing this capacity is that the boiler designer will have the opportunity to make an efficient steam generator within space limitations that may be reasonably allotted. The steam requirements will be reduced to a maximum generation in the range from 45,000 to 55,000 lb. per hr. instead of the 100,000 or more lb. per hr. required by large modern passenger and freight reciprocating-engine locomotives.

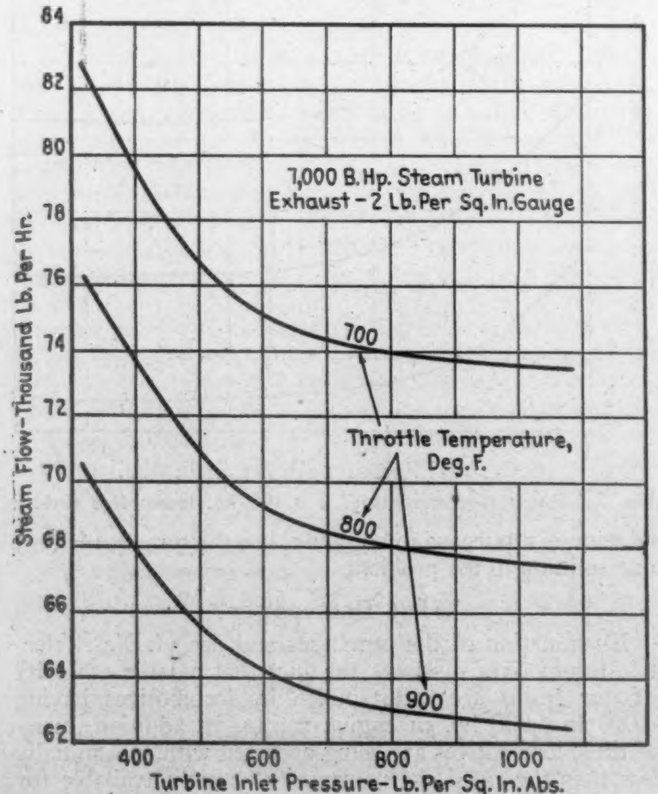


Fig. 4—Steam requirements of a 7,000-hp. locomotive turbine

A set of curves, Fig. 1 to 4 inclusive, has been drawn to illustrate the effect of steam pressure, steam temperature and capacity on the steam required by a turbine for locomotive application. All data are on the basis of 2 lb. per sq. in. gauge exhaust pressure, which is adequate to assure exhausting steam clear of the locomotive but not enough to permit use of the exhaust steam to create draft. In consequence the necessary draft for the steam generator must be obtained with a fan, and preferably by forced draft.

Examination of these curves will show that both steam temperature and steam pressure have a marked effect on the quantity of steam required. If another curve were drawn for 1,000 deg. F. steam temperature there would be a further reduction, but there is doubt of the advisability of using the additional quantity of high alloy steel in a locomotive where as much operation occurs at low capacity and low temperature as at high capacity. There is very little reduction in the quantity of steam required for pressures over 600 pounds. This is particularly true for the 4,000-hp. turbine. The four illustrations, though quite similar, have been included both to show actual values of steam required and to show that a higher steam pressure is somewhat more desirable for a large locomotive than for a small one.

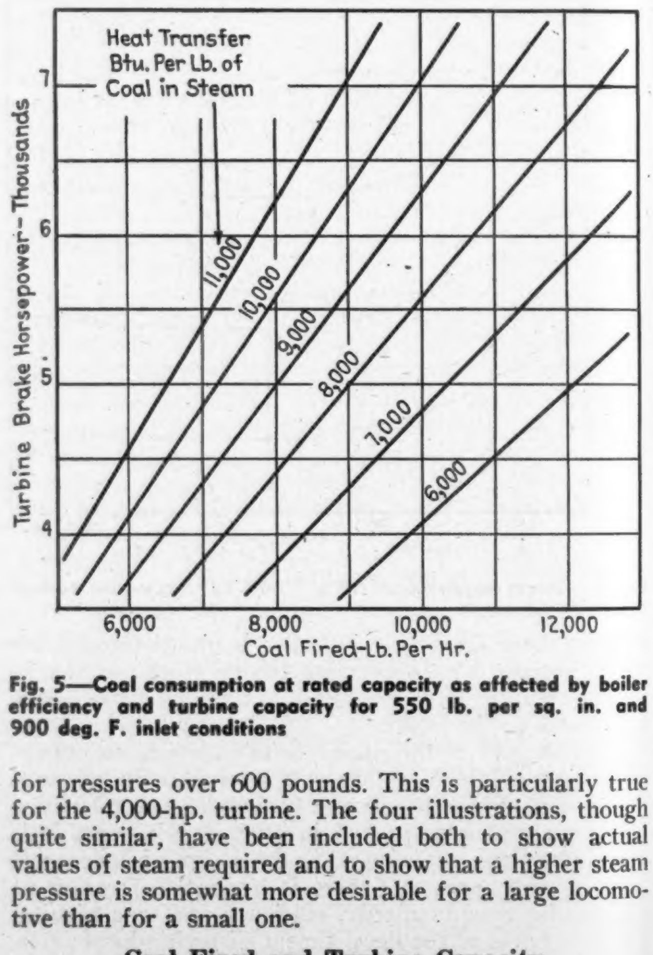


Fig. 5—Coal consumption at rated capacity as affected by boiler efficiency and turbine capacity for 550 lb. per sq. in. and 900 deg. F. inlet conditions

Coal Fired and Turbine Capacity

The total steam requirements of 45,000 to 55,000 lb. per hr. for a 4,000- to 5,000-hp. locomotive apply to steam pressures of 550 lb. or over and to a steam temperature of 900 deg. F. These conditions are considered entirely practical for locomotive service insofar as the main turbine and the larger steam-driven auxiliaries are concerned. The smaller auxiliary engines should operate on saturated steam. On the basis of operation in many industrial steam plants using treated feed water and 100 per cent make-up, it would appear that the same set of conditions are also practical in the case of a locomotive boiler.

A factor of increasing importance is the quantity of coal fired. Fig. 5 has been drawn to illustrate the relation between coal fired and turbine capacity. Boiler and fur-

nace efficiency are drawn as a parameter by showing the amount of heat transferred to the steam. All these data apply to a turbine supplied with steam at 550 lb. per sq. in. and 900 deg. F. and with an exhaust pressure of 2 lb. per sq. in. gauge. The auxiliaries have been assumed to require one-sixth of the total steam generated. If, for example, a steam generator could be designed to transfer 11,000 B.t.u. of the heat in the coal to the steam, a turbine would develop 7,000 b. hp. for traction on 9,000 lb. of coal per hour.

Applying this to a specific case, if a boiler and furnace can be designed to absorb 10,000 B.t.u. per pound of coal burned (77 per cent efficiency for 13,000 B.t.u. coal), a turbine will develop 4,100 b. hp. on 6,000 lb. of coal per hour. If the locomotive operates at 80 per cent of this capacity for 10 hours, it will require about 25 tons of coal. Water consumption will be at a rate of about 4,200 gallons per hour. These figures are of extreme significance for they show that coal and water consumption per horsepower hour is about 60 per cent of any coal-burning steam locomotive now in operation. With the electric transmission coal and water carried may well be only one-half the present amounts for the same work done in certain territory.

One may conclude that the burden of responsibility for future progress rests with the designer and builder of the boiler and furnace. While this may be true to some degree, the requirements for this item of apparatus have been so drastically modified that he has a genuine opportunity to produce the practical, efficient, coal-burning water-tube boiler so essential to an improved steam locomotive.

Perhaps, in time, the coal-burning steam locomotive will be supplanted by some promising new form of motive power. However, these new forms of motive power that will utilize solid fuel appear to be a good many years from reaching a stage of development useful to the railroads. A logical plan in undertaking the creation of an improved steam locomotive is to make the best possible use of the existing technical knowledge pertaining to all of its components.

This procedure should result in a locomotive more than competitive with the best on the railroads, plus utilizing coal as its fuel.

Aluminum in Freight Car Construction

(*Continued from page* 64)

the answer for any one problem is approximately the same by both methods. These formulae for the evaluation of light weight may be used in studying new designs. We used them when we were working up the suggested design of open and covered hopper cars, which we have previously mentioned, to prove the efficiency of our design.

At present prices of materials a cost differential exists over standard steel cars when weight saving materials are used. We are hopeful that the increased use of aluminum materials in freight cars will permit cost reductions which will be reflected in lowering these increased cost differentials.

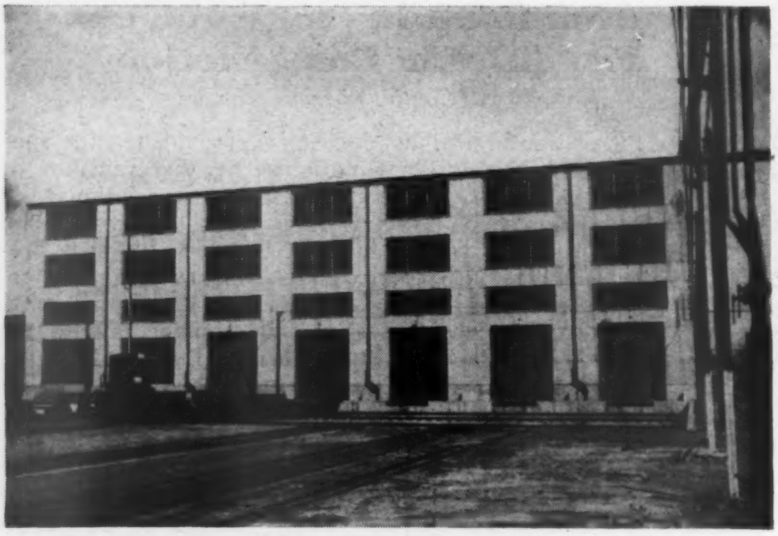
The greatest economic benefit will not be obtained with small numbers of lightweight cars but will be realized as every railroad obtains more and more lightweight equipment. It would seem only logical that in this day of large buying of freight equipment the lightweight program should begin now.

In calculations which attempt to determine the value of weight saving, the figure most generally used for the cost of hauling non-revenue weight is one mill per ton-mile; sometimes it even gets to three mills. Since 1939 the average straight-time hourly rate of railroad employees has risen 52.2 per cent. The cost of fuel (coal and oil) in the same period has risen 101.0 per cent; in fact, since 1933, this latter cost has risen 236.5 per cent. Since the one-mill figure was established in the late '20's, we wonder if this cost of hauling non-revenue weight would hold true today or whether it has not now increased to that point where the cost of hauling dead weight is decidely uneconomical.

Aluminum is one of earth's more abundant metals. With it, weight can be saved without reduction of cross sectional area. Here is bulk and strength to withstand the hard knocks of railroad use. Its immediate availability in all forms today is a challenge to designers, builders, and buyers of freight equipment to thoroughly investigate its advantages and possibilities for future planning.

* * *

One of 37 Diesel-electric locomotives purchased by the National Railways of Mexico in 1946

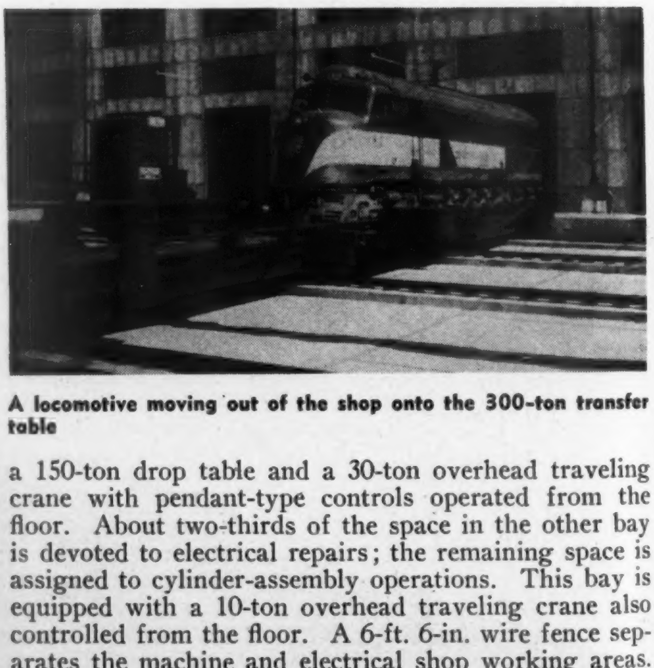


Seaboard's Diesel Shop

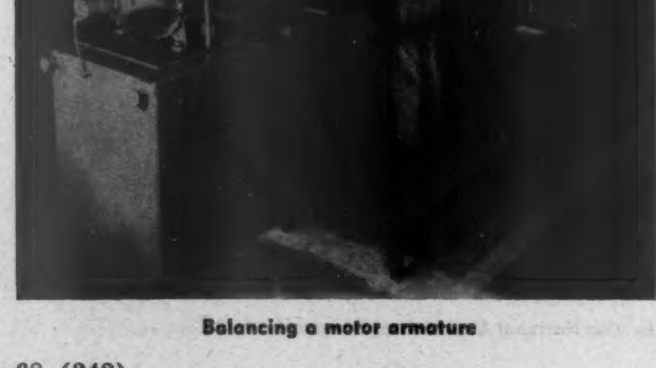
Heavy repair work to all classes of Diesel power is being turned out at an up-to-date plant built at Jacksonville, Fla.—Facilities include paint shop and storehouse

To repair its present fleet of more than 150 Diesel-electric locomotives the Seaboard Air Line, on May 1, 1947, started operating the first completely new Diesel shop facilities in the southeast. Located adjacent to the railroad's steam backshop and engine terminal at Jacksonville, Fla., the new plant consists of a main machine and electrical shop, a paint shop and a storehouse for replacement parts.

The accompanying drawing shows the layout of the main shop building. It is a rectangular steel and concrete structure, approximately 178 ft. by 205 ft. with two bays and an exterior of corrugated asbestos. The larger bay is used for dismantling and rebuilding operations and for Diesel engine repairs. It is served by a 150-ton drop table and a 30-ton overhead traveling crane with pendant-type controls operated from the floor. About two-thirds of the space in the other bay is devoted to electrical repairs; the remaining space is assigned to cylinder-assembly operations. This bay is equipped with a 10-ton overhead traveling crane also controlled from the floor. A 6-ft. 6-in. wire fence separates the machine and electrical shop working areas.



A locomotive moving out of the shop onto the 300-ton transfer table



Balancing a motor armature

Locomotives can be placed on any one of five tracks entering the building on the west side by means of the 300-ton transfer table. Four of these tracks are stub-end in the machine bay, the fifth track runs through the shop and into the steam backshop. In the opposite direction this track is in line with the single track in the paint shop on the other side of the transfer table pit. The transfer table, traveling cranes and the drop-pit table were supplied by the Whiting Corporation.

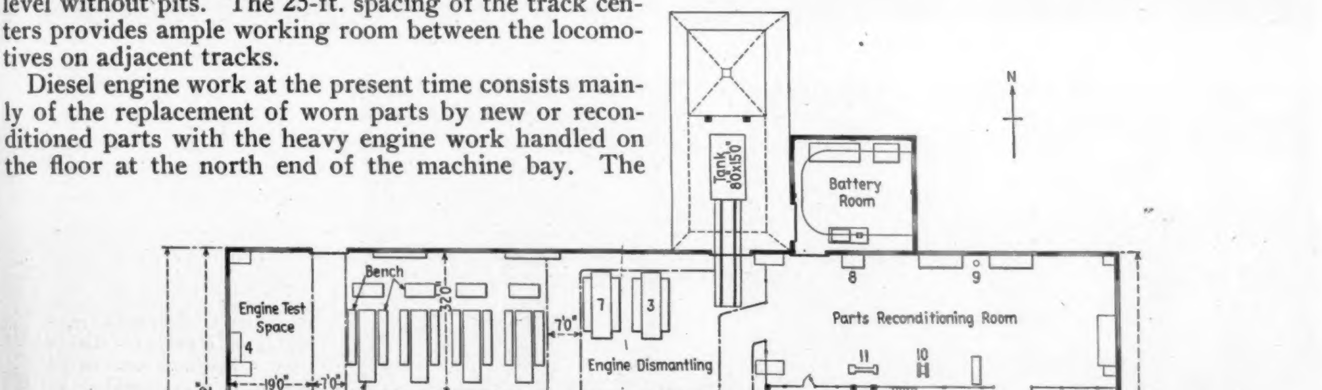
The drop-table pit spans the two southernmost tracks and includes a locomotive body support with hooks of 80 tons capacity suspended from an overhead trolley that can be moved a distance of 30 ft. along one track,

The paint shop is located directly across from the main shop at one end of the transfer-pit table

A main generator is lifted from a locomotive by the 30-ton traveling crane—The crane controls are being operated by a workman at the job inside the cab—The locomotive-body-support arrangement for the drop table is shown at the extreme right

as shown in one of the illustrations. One-half of the second track from the south side of the building has an inspection pit flanked by depressed floors for making the running gear more accessible to the workmen. The third stub-end track spans an inspection pit for its entire length. The fourth and fifth tracks are at floor level without pits. The 25-ft. spacing of the track centers provides ample working room between the locomotives on adjacent tracks.

Diesel engine work at the present time consists mainly of the replacement of worn parts by new or reconditioned parts with the heavy engine work handled on the floor at the north end of the machine bay. The



1—Storage space for parts removed from locomotives under repair
2—Welding compartment
3—Miscellaneous parts storage
4—Filter test bench
7—Engine parts stripping bench and pans
8—Oil-cooler test table
9—Hand honing machine
10—Floor grinder
11—Engine lathe
12—Generator and motor disassembly
13—Motor-stripping benches
14—Testing benches (motors)
15—Generator and traction-motor running tests
16—Generator and traction-motor assembly
17—Armature lathe
18—Armature stands
19—Armature-turning stand
20—Baking ovens
21—Varnish and impregnating tanks
22—Small parts repair shop
23—Vacuum pump
24—Gisholt Dynetric balancing machine

Plan of main Diesel shop and key to equipment installed

Above left: Removing motor lead clamps — Above right: Bearings are fitted and motors assembled at this bench — Left: The shop office is elevated 8 ft. above the floor in the electric-shop bay—Below: Preparing back connections on a motor armature for brazing

cylinder-head assemblies are rebuilt at the north end of the smaller bay. All truck work is handled in the steam backshop. After repairs have been made to the engines they are run in for an extended period with a load on the main generator. The generator load is furnished by a General Electric load tester mounted on a hand push truck that can be moved to any track.

Electrical Repair Equipment

The electrical shop makes all classes of repairs to electric motors and generators. Special equipment and facilities for making these repairs include a Peerless Universal armature machine, a Gisholt Dynetric balancing machine and an impregnating room with two Young Brothers' baking ovens, a Devine vacuum impregnating tank, a varnish tank and an armature cool-

ing stand. The impregnating room is served by a five-ton Yale electric hoist, controlled from the floor and suspended from a monorail. The shop also has special stands on which armatures are placed and rotated during rewinding or coil-replacement operations. Motor and generator disassembly and assembly work and testing is done on the floor in the shop areas indicated on the drawing.

The main shop has excellent natural lighting furnished by the large amount of window area that occupies about one-half of the side-wall space. Artificial illumination is produced by 42, 1,000-watt ceiling lights and 46, 200-watt side-wall lights.

A special color scheme has been applied to the shop interior. The ceiling and rafters are a seafoam green; side walls and columns are finished in suntone yellow.

Lowering an armature on the baking-oven dolly in the impregnating room

Left to right: The armature-cooling stand, the varnish tank, and the impregnating tank

The interior of the paint shop

Stripping an armature—For rotating the armature easily it is mounted on old motor bearings that fit into cups on the stand

The machinery and equipment are painted horizon gray and spotlight buff, except for the cranes which are a focal yellow. Floor stripes are a traffic yellow.

The paint-shop interior, as shown in one of the illustrations, has a single track flanked by working platforms that can be moved vertically. The exhaust hood and all spray-paint equipment was supplied by the DeVilbiss Company. Lighting is furnished by 48, 200-watt lights.

The Diesel parts storehouse is a one-story structure having a floor area of 10,500 sq. ft. and is located north of the main shop building. It is connected to the shop by a concrete roadway in order that parts may be moved readily by shop trucks.

EDITORIALS

Power from the Atom

Atomic energy, or more properly, nuclear energy, has fired the imagination of almost everyone. Its discovery resulted in the development of the atomic bomb. It is now possible to effect transmutation—(at great expense)—to make one element into another. The production of new radio-active isotopes have given the medical profession new tools for exploration of the human body and has provided industry with new means of controlling manufacturing processes. Controlled release of nuclear energy can apparently be used to develop electric power.

Aside from the devastating effect atomic bombs might have on railroad facilities, the only other visible application of nuclear energy to railroad operation, would be the production of power. Two types of power plants are indicated by present circumstances. One of these, a primary power plant, would develop power from uranium. It would occupy large ground space and could produce a bi-product of plutonium. It would apparently be necessary for it to generate so large a block of power, that only a few such plants, located near load centers are indicated. The necessary high temperatures required for the generation of power-plant steam create special problems with the metals used in atomic piles. For this reason, they might become sources of relatively low-temperature heat rather than electric power. The plutonium bi-product could, in turn, be used to operate smaller plants of the order of 20,000 to 100,000 kw. These would require no more ground space than a coal-fired plant of similar capacity.

The cost of power at primary and secondary plants would depend upon the price charged for plutonium. According to an estimate made in one of the best reports on the subject, "The International Control of Atomic Energy: Scientific Information Transmitted to the United Nations Atomic Energy Commission, June 14, 1946—October 14, 1946", equality of operating costs between coal power plants and nuclear power plants would be reached if the coal cost $10 per ton. At this price, the advantage of nuclear power plants would be less in the United States than in many other countries.

A considerable amount of shielding would be required to protect operators from lethal radiation, even in the secondary plants. This would preclude their use in automobiles, and probably in airplanes, or locomotives. They might be used in ships. Stationary power plants appear to be the most important potential application. For those who wish to study such possibilities in greater detail, a report, "Some Economic Implications of Atomic Energy", by Walter Isard, Massachusetts Institute of Technology, is summarized in the Quarterly Journal of Economics, Harvard University Press, February, 1948.

It is conceivable that since secondary plants would not require fuel in bulk, they might be located at points which would reduce the shipment of unrefined materials, the processing being done at the point of origin. Generally, it would appear that such plants would be properties of existing utility companies. At present, the cost of power generated in such plants would be prohibitive, but with rising prices of oil and coal, and improvements in the production of plutonium, they might make the cost of electrical power from networks considerably less than that produced on locomotives. Under such a circumstance, there would be an added reason for more electrification of railroads.

All of this is projecting an idea pretty far into the future. In any event, the influence of nuclear energy development, aside from its use as a bomb, is not one which need cause the railroads any immediate concern.

Evaluating Welding Society Participation

In last month's issue a discussion of the relations between the railroads and the American Welding Society was presented by L. E. Grant as chairman of the Cutting and Welding Committee, Electrical Section, Mechanical Division, Association of American Railroads. Acting for that committee Mr. Grant set forth several reasons why the railroads should support the society. All of his reasons were sound. They were of the kind that most railroads have found to be excellent ones for working with other organizations that deal only with railroad problems. If these reasons could be evaluated in terms of dollars and cents saved they would be of more significance to the men making the decision on entering into the society's activities. It is difficult, however, to evaluate accurately the benefits accruing from the participation of the railroads in the activities of an association or technical society and determine whether or not the return on the investment is enough to warrant the expenditure of the time and money.

Concrete evidence of the value of society meetings can be obtained by getting ideas about new methods that have been studied. As an example, the trend toward the more widespread use of a.c. welding equipment is a relatively new development. A recent study involving the replacement of 27 d.c. welding machines by 27 a.c. machines showed that a savings in power costs alone of nearly $10,000 was made by the changeover—enough to pay for all the electrodes used in one year with enough left over to pay for the cost of the equipment in 5½ years. It is this kind of information that can be obtained

at a meeting of welding engineers which can be given a definite dollars-and-cents valuation.

New developments in welding and the associated processes are being made constantly. On a business basis the railroads must keep up with these developments and investigate those that show promise of producing savings. There is no better way to find out about the possibilities than to join with others who have the advancement of the art of welding as their common objective.

Why Spend All The Money in One Place?

One of the most difficult things to understand, over the period of the past two or three years, is the concentration of thinking on the part of many mechanical officers and supervisors on the problems related to the maintenance and operation of Diesel-electric power. This has been almost to the exclusion of any consideration of the fact that the railroads of the United States still have more than 35,000 steam locomotives in service which, by any method of calculation, will have to be serviced and maintained for many years to come. Hardly a week goes by that we do not hear of a railroad which has purchased ten, twenty, or fifty Diesel-electric road locomotives and immediately goes ahead with plans for new repair facilities for Diesel servicing, inspection and repair involving expenditures from several thousand to several million dollars. And they do this without question.

For years the attention of the railroad industry has been drawn to the fact that its back shop and engine terminal facilities are to a large extent obsolete and when it is considered that for more than six or seven years the cost of everything involved in railroad maintenance has been going up out of proportion to the gain in revenues it would seem obvious that the industry should embrace every opportunity to effect real and substantial economies by whatever means possible. As rapid as has been the introduction of the Diesel into the motive-power field and as spectacular as may be the economies credited to its use, it doesn't make sense that the major part of the appropriations for shop and engine-terminal improvements should be allocated to the installation of modern facilities for the servicing and maintenance of between 10 and 15 per cent of the motive-power inventory to the neglect of the facilities needed to maintain the other 85 to 90 per cent.

With the exception of a few of the more progressive roads, almost none have had programs of modernization of engine terminals for the handling of steam power for many years. In the case of the few exceptions where studies have been made and new terminal facilities in the form of better track arrangements, better coal- and ash-handling equipment, better inspection facilities, modern lubrication stations, and modern machine tools and shop equipment within the enginehouse have been installed the investment has paid handsome returns to those roads which have had the foresight to make the most of their opportunities.

Considerable criticism has been directed at the continually increasing state of obsolescence of the machine tools and shop equipment in the average locomotive and car shop used for making heavy repairs. Here, again, due credit must be given the roads that have planned co-ordinated modernization programs for heavy repair facilities for they have not only been able to keep down, or substantially reduce, the out-of-service time that locomotives or cars require during the overhaul operations, but in most cases these modernization programs have definitely effected material decreases in the unit costs of shop operations. The experience of a few progressive roads has demonstrated that most roads are throwing away dollars every day that might well be saved and put to profitable use.

It has always been assumed that an annual saving of from 16 to 18 per cent on the investment would justify expenditures for improvements. It has been shown that a wide-awake shop engineering department can find plenty of places around shops and engine terminals where a variety of items of machine tools and shop equipment can be installed that will pay for themselves in from *30 to 60 months.*

It shouldn't be a difficult matter for an accountant or an engineer to convince railroad management that even if it *might be desirable* for a railroad with, say, 200 or more locomotives to replace *all* the steam power with Diesel, it is still going to be several years before such a complete change could be brought about. In the meantime, the cost of handling steam power in obsolete shops and terminals is mounting higher and higher. The increasing obsolescence with each passing year broadens the field of opportunity for the use of modern equipment that will not only help keep locomotives and cars out on the road where they can be used to produce revenue but will accomplish that end at reduced unit costs.

Random Notes On Magnaflux Testing

The second national conference on Railroad Magnaflux Testing, held at Chicago and attended by upwards of 150 railroad men and others interested in the subject, developed fully as much pertinent information and exchange of ideas as the first conference two years ago. As pointed out by the chief mechanical officer who opened the two-day meeting this year, it is of the utmost importance,. first, to determine which equipment parts need checking with Magnaflux, Zyglo and other non-destructive test methods and, second, to organize the work so it can be done on a production basis and not be a bottle neck in repair shop operation.

A further vital requirement is to make sure that inspectors know what to look for in the way of defects,

where they are most likely to be located, and how important it is not to overlook any. In examining car axles with Magnaflux test equipment, as now required by A. A. R. rules, for example, it may happen that 100 or more axles are checked before discovering one with a defect. As a consequence, inspectors are likely to consider the work more or less routine and become careless, with the result that a defective axle passes the inspection point, is returned to service, and causes a train derailment, personal injuries, possibly death, and extensive property loss. When this happens, the money cost alone may exceed the entire expense of Magnafluxing all axles on the railroad for a number of years.

Facts proving the necessity for ceaseless vigilance in inspecting all critical equipment parts should obviously be brought to the attention of inspectors in as forceful a manner as possible. This can be done while instructing new men in their work by word of mouth, by monthly bulletins, and by publicizing, system wide, any exceptional instances of defects discovered which might have resulted in serious accidents. It might also be a good idea to post on each shop bulletin board, or on a portable board located at the Magnaflux machine, a large-scale picture of a derailment caused by failure of some equipment part and thus serve as a constant reminder to inspectors.

Still further in connection with the human element in non-destructive testing of railway equipment parts, it was brought out at the conference that inspectors should be carefully chosen, thoroughly instructed, and paid a sufficiently high rate so that they will not bid off some other job a few months after they have really become proficient in locating defects. Relief operators of inspection equipment should be required to work the machines at least one shift every two or three weeks so as not to forget all they have learned and be available in case the regular operators are away.

Another essential precaution is to give operators periodic vision tests to make sure that any using eyeglasses are suitably fitted. An incident which might have proved disastrous occurred recently when a shop foreman, passing the Magnaflux machine, noticed indications of a car-axle crack which the operator apparently was overlooking. Investigation developed that the operator had left his glasses home that morning and was attempting to perform critical inspection work without them!

It cannot be questioned that the cost of inspection with Magnaflux in most railroad shops is higher than it should be. The greatest cost is labor, far outweighing costs of equipment, materials, power and the like. That portion of labor required for material handling is usually several times the actual inspection labor.

In reducing costs, the first step is the use of specialized instead of general-purpose equipment. Most present Magnaflux railroad installations involve general-purpose machines because of the wide variety of parts inspected. Many wheel shops, on the other hand, make use of specialized equipment, reducing the cost from over one dollar an axle to 20 or 30 cents an axle.

A typical railroad's Magnaflux inspection experience, made available at the conference, shows the following: Axles inspected, 70,000; axles found cracked, 3,500; axles found cracked between the wheat seats, 34; cracked axles salvaged by turning to smaller size, 2,100; axles scrapped, 1,400.

Permanent vs. Portable Scaffolding

In any passenger- or freight-car major repair shop, scaffolding of some sort is necessary for the performance of the work involved in overhauling rolling stock. The efficiency with which the work is done can be dependent to a large extent upon the type of scaffolding in use. The usual form of permanent scaffolding offers versatility, ease of adjustment to various levels, and convenience to the working area. While these are minimum essentials to be realized in order that a suitable quantity and quality of work may be performed from the scaffolds, it must also be kept in mind constantly that the work from the scaffold does not comprise the total done upon the car exterior. Non-interference of the scaffold or its supports with exterior work other than that performed on it deserves equal consideration.

Portable scaffolding offers the ultimate in non-interference with other work, while at the same time it can be made flexible enough to accommodate virtually any work that is normally done on permanent scaffolding. Different levels at which various jobs are most efficiently performed can be attained in portable scaffolding by designing individual units of varying heights. Portable units made with platforms of varying heights offer the advantages of permanent scaffolding plus the additional, and very important, advantage of easy movability from an area where scaffolding supports would interfere with other work. This is of particular importance in the overhaul of modern passenger cars because of the great amount of heavy equipment mounted on the underframing. Portable scaffolding which can be moved clear of the area in which non-scaffold work is being done does not hinder the removal or application of heavy parts. Air-conditioning units, generators, and batteries are a few examples of cases where a clear path is a valuable time saver in mounting or dismounting heavy parts.

At least one modern passenger-car repair shop has been designed and is operating without any form of permanent scaffolding. The result is clear, spacious aisles for transporting materials, and unobstructed working areas for exterior work on the lower parts of the cars. Cars do not have to be spotted, and perhaps moved several times, during the course of an overhaul, in order to remove or apply heavy underframe equipment or to handle other work which would be obstructed by the scaffolding supports. At the same time portable scaffolds furnish safe and flexible platform supports for work anywhere along the side of the car and are usable across the ends of the car as well.

THE READER'S PAGE

Load Compensating Brake and Freight-Car Weight Reduction

To the Editor:

The March 1948 issue of *Railway Mechanical Engineer* carried an editorial entitled "Freight-Car Weight Reduction" that revealed two interesting facts.

1—That it had been established that it is practical to reduce the weight of 50-ton hopper cars to a value that "permitted a ratio of pay load to gross load of upwards of 82 per cent."

2—That about two thirds of the 50-ton hopper cars ordered in 1947 weighed "less than the minimum at which the single capacity brake will meet both maximum and minimum braking ratios."

I think that it would be of interest to enlarge on these statements somewhat and point out the relationship between weight reductions and braking ratios so that it may readily be determined the degree of handicap on weight reduction that is imposed by the single capacity brake.

With respect to point number one, 82 per cent payload-gross-load ratio establishes the empty car weight at 30,420 lb. This, of course, is determined by taking the pay load as 82 per cent of the axle load limit of 169,000 lb. and subtracting it from that gross load figure. Now 75 per cent braking ratio of the empty car provides a braking force of 22,815 lb. With the single-capacity brake this same force only is available for braking the loaded car and in order that the braking ratio does not fall below 18 per cent we find that the gross load of the car must not exceed 126,700 lb. Since the axle capacity is 169,000 lb. it follows that a pay load of 42,300 lb. is sacrificed.

Since hopper cars are the type that usually are loaded to capacity it would not take long to pay for brake equipment that would permit the handling of this extra pay load. There are four ways in which savings can be effected through the use of a multicapacity brake:

(a) The saving in fuel in hauling empty cars that weigh up to 11,000 lb. less.

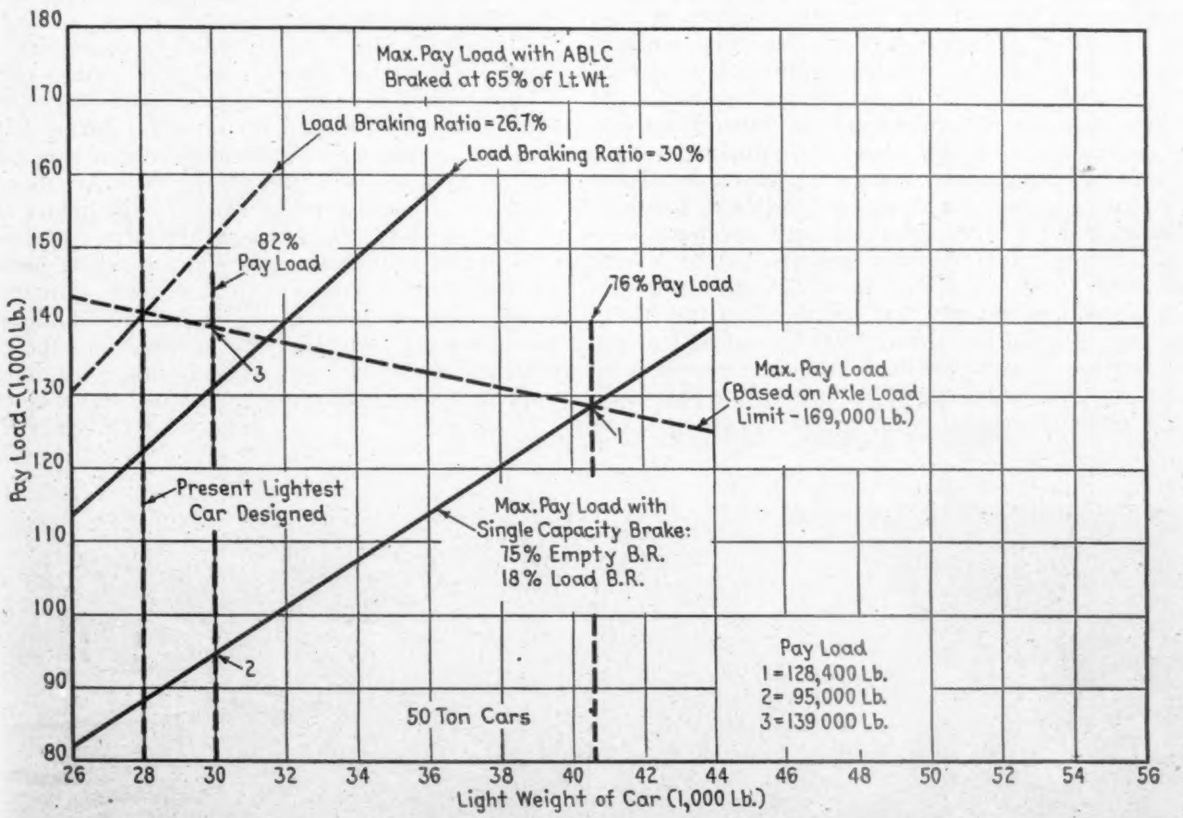
(b) The saving in hauling very much larger pay loads.

(c) The saving in stopping distance due to very material increase in braking forces on the loaded car.

(d) The saving in wear and tear to equipment due to the more uniform braking forces on empty and loaded cars.

In the case of the single-capacity brake, the range in braking ratios is 18 to 75 per cent and with the load compensating brake the range is 30 to 65 per cent.

With respect to point number two, the exact weight of the empty cars built in 1947 is not given but at least one an empty weight of 28,000 lb. A glance at the graph will show the sacrifice in pay load for each increment of empty-car weight reduction.



Effect of braking ratios on loading of lightweight freight cars—Per cent of 1947 orders for 50-ton cars weighing under 40,600 lb.: hopper cars, 66; gondolas, 10; box cars, 16

The bottom sloping line shows the reduction in pay load as the light weight is reduced below 40,600 lb. which is the minimum tare weight of a car that can carry an axle capacity load with the single-capacity brake. The broken line indicates the pay load that can be carried when the Load Compensating feature is added to the AB brake equipment. The difference between these two

pay load figures represents the increase in pay load due to this added feature. As a specific example, assume a light car weight of 30,000 lb. If the single-capacity brake is employed the pay load is found at reference number (2) and moving along the horizontal line to the left we find that the permissible pay load is 94,000 lb. If the Load Compensating feature is added the pay load is found at reference number (3) and the permissible pay load is found to be 139,000 lb. To say this another way, for every hundred lb. weight saving below 40,600 lb. tare weight the pay load is reduced 317 lb. if the single-capacity brake is retained. If the Load Compensating feature is added the pay load may be increased 417 lb. for every 100 lb. reduction in tare weight.

C. D. STEWART, VICE PRESIDENT,
Westinghouse Air Brake Company

Present Status of Freight Car Weight

To the EDITOR:

Your comments in the editorial entitled "Freight Car Weight Reduction" printed in the March, 1948, *Railway Mechanical Engineer,* set forth clearly some of the factors that have hampered improvement in the ratio of payload to gross load since 1937, when the present braking requirements were adopted. When comparing weights with the minimums for which the single-capacity brake is permissible, however, consideration of additional factors indicates more definitely the extent to which lightweight construction has been adopted for various types of cars.

The majority of carbon-steel hopper cars conform closely to the A.A.R. standard design. The normal weights of such cars vary, depending on the trucks and specialties used, but fall within narrow limits. The Committee on Car Construction shows the estimated weight of its standard 50-ton carbon-steel hopper car as 41,400 lb. The figure given in the Mechanical Advisory Committee Report is 39,960 lb., evidently with one-wear steel wheels. Corresponding estimated weights for the A.A.R. 70-ton hopper car are 47,600 to 47,900 lb. with steel wheels. Therefore, the fact that two thirds of the 50-ton hopper cars weighed less than 40,600 lb. and half of the 70-ton cars less than 50,400 lb. does not necessarily indicate that any deliberate effort has been made to reduce weights, but simply agrees with the normal weight variation of the A.A.R. standard designs. Some railroads have even increased thicknesses of body sheets to increase the lightweight to the minimum for the single-capacity brake. Other roads, finding the weight below the minimum have raised the braking ratio on the empty car above 75 per cent or increased the brake-pipe pressure to secure 18 per cent on the cars when fully loaded.

Boxcars involve conditions quite different from those of hopper cars. The A.A.R. 50-ton 40 ft. 6 in. boxcar normally weighs about 46,800 lb. and 50 ft. 6 in. cars about 55,000 lb. Therefore, if the shorter boxcar even approaches the dividing line of 40,600 lb., it represents a weight reduction of about 6,000 lb.

Gondola cars of the several common types and lengths, of both 50-ton and 70-ton capacities, vary much more than box or hopper cars in designs and in weights. A large majority exceed the minimum weight for the single-capacity brake, but a more detailed classification would be required to determine definitely the significance of weight as compared to limits which are set by brake regulations.

A record of freight cars for which the writer's company furnished high-strength steel indicates the extent of weight reduction in freight cars of various types, because that material is usually used to secure light construction. Comparing the number of high-strength steel cars of each type with the total cars of that type ordered in 1947 shows that gondolas had the highest per cent of Cor-Ten applications, boxcars ranked second and hopper cars third. All the gondolas and boxcars had plain AB brakes, but a considerable number of hopper cars were equipped with load-compensating brakes.

Committees who have analyzed the economics of lightweight freight cars have agreed that savings per ton of weight reduction in gondolas and hopper cars are two to three times the savings in boxcars. Yet during 1947, Cor-Ten was specified for a larger per cent of boxcars, which can be lightened with the plain AB brake, than hopper cars, which need special brakes if built lighter than the A.A.R. standard. Furthermore, the largest percentage of Cor-Ten equipment was in gondolas, which permit substantial weight reduction and savings without special brakes. This, we believe, proves that the braking problem constitutes a present barrier which prevents the railroads from achieving the economic advantages of lightweight equipment with high ratios of payload to gross load.

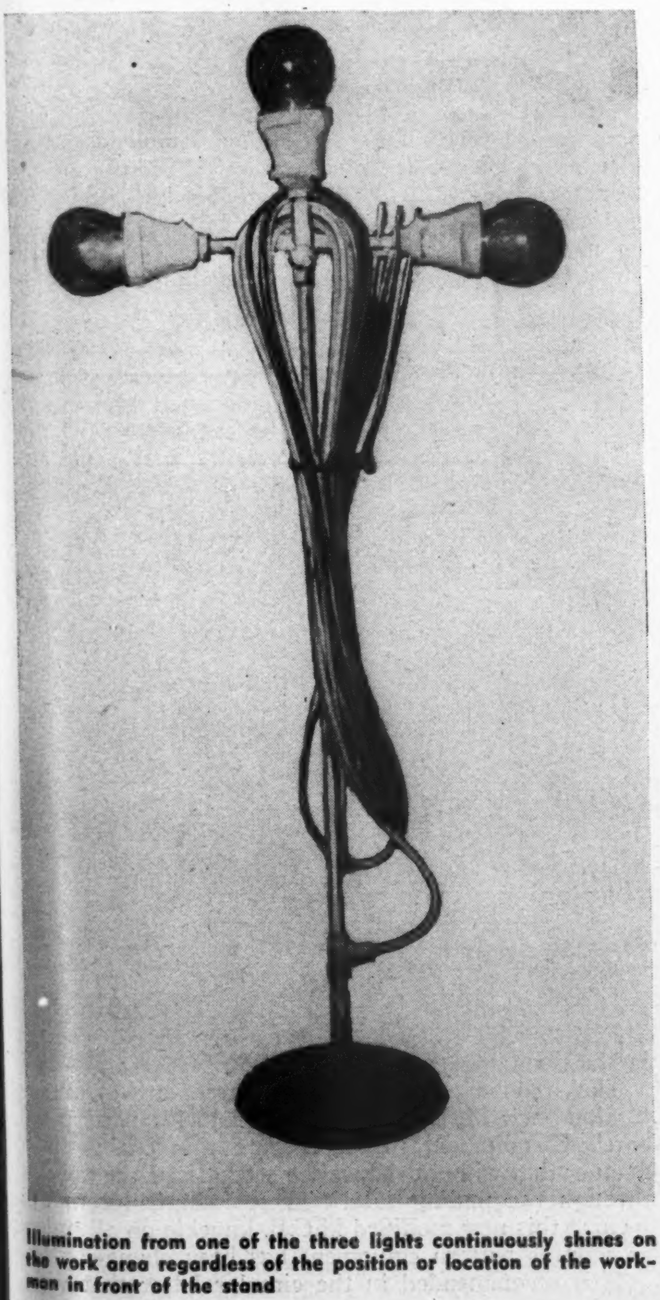
A. F. STUEBING

* * *

With the
Car Foremen and Inspectors

Shadowless Light

A novel arrangement that furnishes shadowless light for cleaning, painting and other miscellaneous work on the interior of passenger cars has been designed and constructed by the shop forces at the Chicago, Rock Island & Pacific Forty-ninth street passenger-car shop at Chicago. The lighting fixture is in the general shape of a cross and contains a light bulb in an explosion-proof fixture in its top and in each of its two side extremities. The three bulbs are so spaced with respect to each other that, regardless of the location or position of the workman, at least one of the lights is at all times illuminating the work area without shining in his eyes when the fixture is placed behind the man. The superior illumination that results from the three-light fixture results in better workmanship and reduced working time in two ways: the work can proceed at a faster pace consistent with quality and the time lost from moving or locating the usual single-light fixtures or extension cords is eliminated. Three of these lights placed within a passenger car are normally sufficient to furnish the illumination necessary for interior car work.



Illumination from one of the three lights continuously shines on the work area regardless of the position or location of the workman in front of the stand

Construction of the shadowless light is relatively simple and can be completed largely with scrap material. The base is made from a piece of round cast iron about 14 in. in diameter to give the fixture enough weight and width for stability. Welded either directly to the base or to a short length of pipe above the base is a T-section of pipe. The tee is placed low to permit the power cable to enter the fixture at a height that will minimize the hazard of people tripping over the cord. The top of the tee is fastened to a length of ½-in. pipe. At the top of this pipe is a small electrical connection box, from which emanate the three power lines for the three light bulbs.

The lighting stands are equipped with 75 ft. of extension cord to facilitate their placement at any point within a car and with explosion-proof fixtures to permit their use for paint spraying operations. The explosion-proof fixtures, which are of a standard design and purchased complete, are fastened to the three upper extremities of the overall fixture. They have threaded outer globes which are easily removable for cleaning with lye or varnish remover.

Oscillating Lights On Suburban Trains

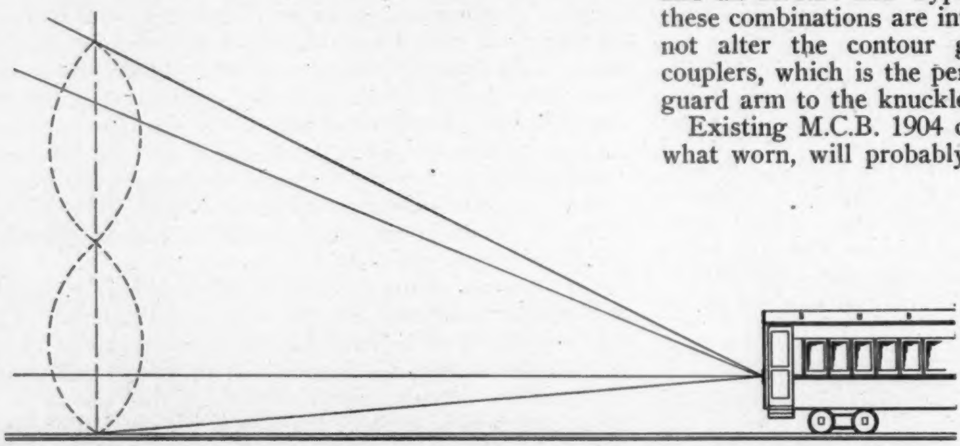
According to the March North Western Newsliner, 66 suburban trains of the C. & N. W. have been equipped, with Mars rear-end oscillating warning lights and it is the intention of the North Western to have all of its suburban trains equipped with these safety lights. Developed by the North Western in conjunction with the Mars Signal Light Company, the rear-end red light is automatically turned on when the engineman reduces air pressure to apply the brakes. The red light oscillates in a "figure 8" and its rays are visible at great distance, even around curves.

This is described by the operating vice-president of the road as one of the most effective safety devices yet developed for railroad use, being a valuable aid on through trains and a supplementary safety factor in suburban service.

The lights have been installed on the rear end of trains operating over each of the railroad's three suburban territories. Sufficient lights to complete the program will be received and installed. Some of the new lights, in addition to the red light, will have an alternate white light for use when trains are backing up for any considerable distance.

The light is a self-contained unit and when set on "automatic" it operates through a reduction of air pressure by the engineman. On top of the light is a three-position switch which may be set for automatic operation, manual operation or off. The light is connected by a hose to the rear brake pipe hose and its beam describes a large "figure 8."

When the switch is in automatic position and a 15-lb. or more brake-pipe reduction is made the light comes on. The light will continue to operate until the brake-pipe pressure is restored, and a small reset button is pushed in releasing the relay.



Pattern of light thrown by Mars oscillating light on the rear of the train

When the switch lever is in manual position the light will come on and continue to operate until the switch lever is turned to off position.

Ordinarily, when in use, the switch is turned to "automatic", and if an engineman makes a stop with less than a 15-lb. reduction, he makes a further reduction to 15 lb. upon completion of the stop.

Virtually all of the North Western's through trains are equipped with the red rear-end warning light. Additionally, all Diesel-electric freight and passenger locomotives and a number of steam locomotives are equipped with a head end oscillating light which flashes a brilliant white light in the form of a 'figure 8" when the train is in motion and automatically changes to a red "figure 8" when the train is stopped in an emergency.

Since inauguration of the use of this emergency red warning light, it has been credited with preventing two side collisions in multiple-track territory. The oscillating white light is of real benefit in preventing crossing accidents involving highway traffic for the reason that it is more likely to attract the attention of motorists than is the straight beam light.

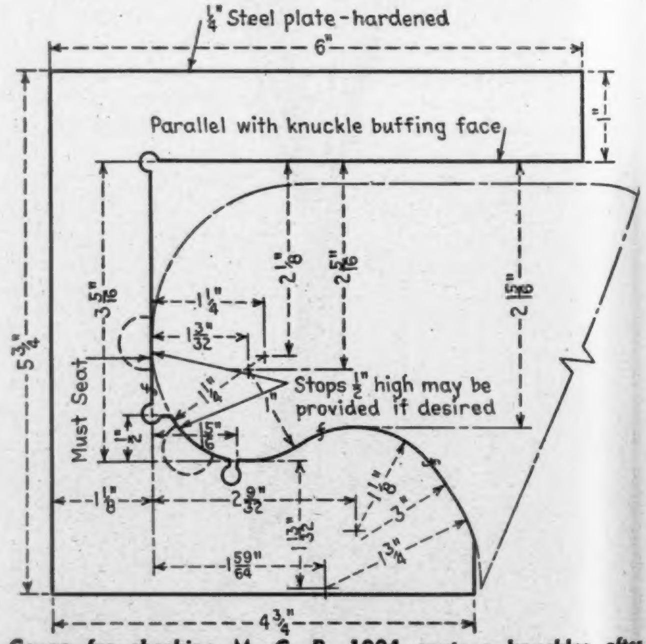
Since these lights were first deevloped on the North Western they have been adopted by a number of railroads throughout the country and are steadily increasing in general usage.

An Intercoupling Problem

According to a circular letter sent out on March 17 by the A. A. R. Mechanical Division, the Committee on Couplers and Draft Gears has received reports of difficulty experienced in intercoupling Type H tightlock couplers with couplers having M.C.B. 1904 contour. The mechanical committee of the standard coupler manufacturers, and the A. A. R. committee, have co-operated with some of the railroads in an effort to find the best possible solution to the problem.

Based on experimental trials, which were later verified by actual car coupling tests, it was found that the preferred method to correct this difficulty is to modify the pulling face of the M.C.B. 1904 contour coupler knuckles as shown in one of the illustrations. This change provides ample clearance for satisfactory intercoupling with the Type H tightlock coupler. It also improves the hook on the pulling face of the M.C.B. knuckles, thus improving the contact relation between two M.C.B. couplers, an M.C.B. and Type E coupler, and an M.C.B. and Type H tightlock coupler, when these combinations are intercoupled. This change will not alter the contour gauge dimension of M.C.B. couplers, which is the perpendicular distance from the guard arm to the knuckle nose.

Existing M.C.B. 1904 contour knuckles when somewhat worn, will probably cause no interference when intercoupling with Type H tightlock couplers, and will therefore not require modification. Existing new or slightly worn M.C.B. 1904 contour knuckles, which will not satisfactorily intercouple can be corrected by removing approximately 3/16 in. of metal at the maximum location, as shown by the shaded area in the illustration. A suitable gauge that may be used to check M.C.B. knuckles, which have been so modified, is shown in the other illustration.

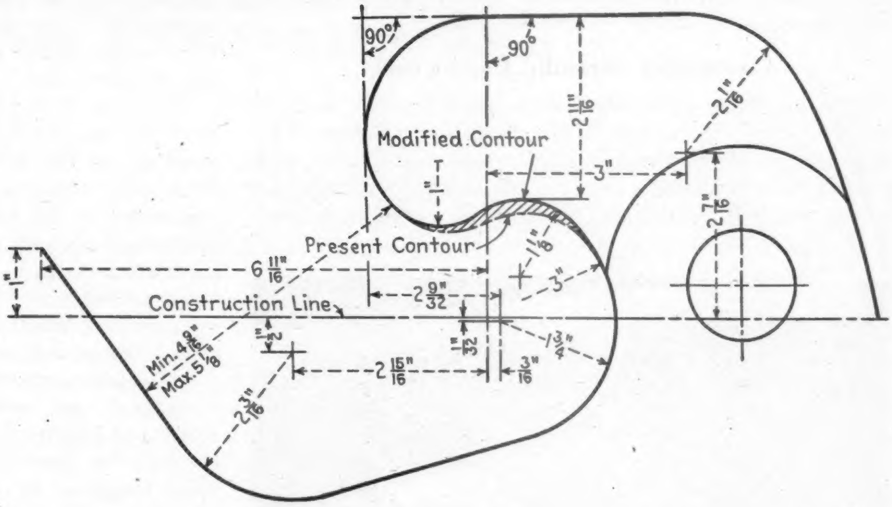


Gauge for checking M. C. B. 1904 contour knuckles after modification

The standard coupler manufacturers are arranging to alter their M.C.B. 1904 contour-knuckle pattern and corebox equipment to incorporate this change in a manner that will not reduce the strength of the knuckle through the pulling face. These manufacturers will furnish this new modified M.C.B. knuckle on all orders as soon as pattern equipment has been changed.

It is recommended in the circular letter that when

Modification to M. C. B. 1904 countour coupler knuckles to permit intercoupling with Type H tightlock couplers



an M.C.B. coupler with 1904 contour cannot be satisfactorily intercoupled with an A. A. R. Type H tightlock coupler, the knuckle in the M.C.B. coupler be replaced with another knuckle of like design in which the modification shown has been made either by the railroad or the manufacturer.

Metallic Steam Connection Repairs

Assembling Metal Insulation Guards

Longer life is obtained from the felt insulation applied to the steam-line metallic connections between cars as well as better protection to workers and inspectors handling these lines by the application of a metal guard at the Rock Island's Forty-ninth street, Chicago, passenger-car shop

Applying the prefabricated piece of galvanized iron which covers the insulation on the car steam-line metallic connections

forces. The guard protects the insulation from water and other damage and retains it in place from shopping to shopping, thereby making it possible for a man to handle the connection with steam in the line.

The piece of felt insulation, which has been previously cut to shape in the shop, is placed in an enameled container which is purchased ready made. The enameled container with the insulation piece is then placed around the main pipe member of the steam-line connections. Over this assembly is placed a section of 26-gauge galvanized

The section of galvanized iron which protects the steam-line connection insulation is secured in place by four rivets set with a squeeze riveter

iron. This galvanized covering is made in the tin shop from a template which outlines both the required contour of the covering and the location of the four holes to be drilled. The final form of the cover for fitting over the assemblage of the line, insulation and enamel container is attained by bending on a hand roller.

The galvanized-iron cover is fastened in place with four hollow rivets secured in position by a pneumatic squeeze riveter. During the riveting operation the assembly is held in a pneumatically-operated vise with a

jaw opening that fits the contour of the finished insulation assembly.

Assembling Metallic Connections

One man can assemble Barco steam-line connections easily, quickly and safely at the Forty-ninth street, Chicago, shops of the Chicago, Rock Island & Pacific, with the aid of a unique device for compressing the ball-joint spring and holding the two parts of the assembly in place

Jig for holding the ball-joint spring compressed while inserting and tightening the four bolts which secure the flanges on Barco steam line connections—The fulcrum end of the lever is shown hooked to the vise-shaft handle—The other end of the lever has an L-shaped rod, the horizontal bar of which slips underneath the end of the work bench opposite the vise and holds the connection joints together by retaining the lever in place

for inserting and tightening the four bolts which hold the joints together. The flanged section which contains the ball joint and the spring in place is held in a vise and the section containing the steam-connecting line placed on top with the two flanges together. The opposite end of the latter member is supported by a block of wood which rests on a piece of strap iron that pivots from the base of the vise.

The spring is compressed and the two flanges held together for the insertion of the four bolts by a lever which runs transversely with respect to the length of the steam line. The fulcrum end of the lever has a hook which fits under the shaft through which the vise handle fits and revolves. About one foot from this end, where the lever rests upon the top member of the assemblage, is the point at which the force from the lever is applied; pushing the lever down at the end opposite the fulcrum compresses the spring and brings the two flanges together. They are held together for the insertion and tightening of the four bolts by hooking an L-shaped rod on the other end of the lever underneath the other end of the bench.

The wood block which supports the one end of the connection is roughed out to the approximate contour of the connection at the place it rests on the wood. A long bolt extends through this block of wood and protrudes about one inch below the bottom. The extension fits into a hole in the strap iron, and the block is held in place with a nut. The swinging support is mounted to the base of the vise and can be pivoted to any desired position as well as swung clear of the working area when not in use. This support is made from a section of strap iron ½ in. by 2 in. It extends horizontally outward from the vise for about 15 in., upward for about 6 in., and then back inward again toward the vise for about 4 in. It is this latter section on which the wooden block rests.

The lever with which the ball-joint spring is compressed is made from a piece of wood, 2 in. by 2 in., the length depending on the width of the bench. On one end is the hook which fastens to the vise-handle shaft and which is connected to the work by a link chain, the end of which bolts to the wood. About 1 ft. from this end is a small piece of 2-in. by 2-in. wood of about 5 in. long. This is set perpendicular to the main piece of wood and is held in place by a length of ⅛-in. by 1½-in. iron which is bent to a U-shape and fits over both pieces of wood.

Two holes are drilled in each side of this piece of U-shaped iron, one pair for inserting a bolt through the main wood section and the other pair for inserting a bolt through the short length of wood. To the free end of the short length of wood is fastened a piece of iron ⅛ in. by 1½ in. bent to fit the round top of the steam-line-connection flange. It is this section which rests upon the connection and applies the force to the spring when it is being compressed. The far end of the lever, the end to which the force is applied, has a length of ¼-in. diameter rod fastened to it. This length of rod is bent to an L shape. When this end of the lever is brought down to compress the spring it is the horizontal part of the L-shaped rod which fits under the bench and holds the lever in place. The length of the main vertical stem of the L of this rod is just long enough to keep the spring compressed snugly, and the horizontal portion which hooks under the bench extends far enough under the bench to assure a firm grip.

Steel Allocation Plan Accepted by 96 Railroads.—The Department of Commerce's Office of Industry Cooperation, as of April 20, had received notices of compliance from 96 prospective railroad participants in the new "voluntary" agreement for the allocation of steel for use in the freight-car building and repair program. The plan, which was framed to conform with Public Law 395 enacted December 30, 1947, supplants arrangements worked out last year by the Office of Defense Transportation and the steel industry. There were 134 railroad participants in the latter. Compliances had also been received from all but two of the eleven contract car builders which were participants in the O.D.T. plan, while all 32 of the interested steel producers had filed. Compliance notices were also coming in from prospective participants among component parts manufacturers and private car lines. The O.I.C. requests for compliances were issued March 31, but no deadline date for the returns was set.

The Safety Score in 1947*

Rank	Railroad	Killed	Injured	Casualty rate per million man-hours 1947	1946
1	U.P.	16	215	1.80	2.95
2	I.C.	15	180	1.96	2.09
3	N. & W.	12	205	3.95	4.50
4	C. & O.	13	342	4.18	3.85
5	Erie	16	321	5.84	7.40
6	A.C.L.	9	369	6.58	8.34
7	C.B. & Q.	10	507	6.92	10.20
8	Southern	19	616	7.00	10.25
9	M.P.	12	543	7.29	5.90
10	L. & N.	19	617	7.30	7.13
11	G.N.	11	542	7.87	8.13
12	C.M.St.P. & P.	20	753	8.21	8.65
13	N.P.	8	521	8.42	8.46
14	B. & O.	26	1,252	8.44	8.03
15	A.T. & S.F.	27	1,518	9.44	12.43
16	S.P.	26	1,544	9.64	11.27
17	C. & N.W.	10	714	9.88	12.55
18	N.Y.C.	52	3,463	10.83	8.34
19	N.Y.N.H. & H.	9	712	11.01	15.85
20	S.A.L.	4	578	12.02	12.35
21	Penna.	87	4,473	12.04	13.76
22	C.R.I. & P.	14	815	14.14	14.43
	Totals and averages	435	20,800	8.62	9.45

*Figures reported by the A.A.R. Safety Section for Group A Railroads (50 million man hours or more per year)

IN THE BACK SHOP AND ENGINEHOUSE

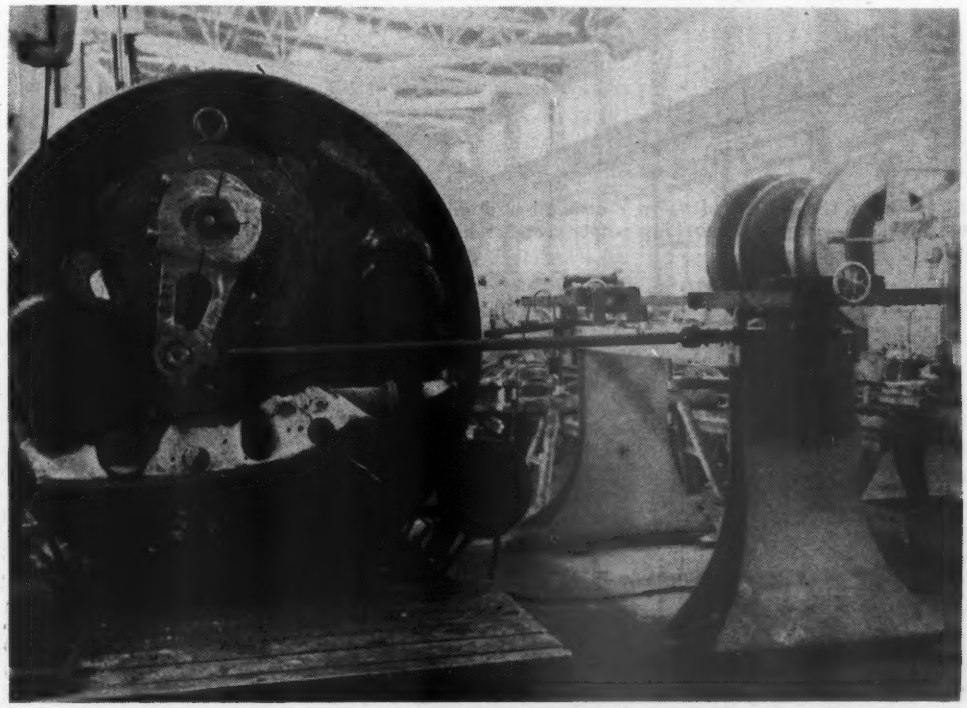
Locating Eccentric Cranks

Eccentric cranks are accurately located for proper throw at the Union Pacific's Omaha shops with a device on which the driving wheels are mounted and revolved. One end of an adjustable rod, which substitutes for the eccentric rod, fits over the pin of the eccentric crank while the other end is connected to a simulated valve crosshead which travels in a simulated valve guide. On the guide is mounted a metallic gauge on which lines are scribed to indicate the proper crosshead travel, or eccentric-crank throw, for each class of locomotive.

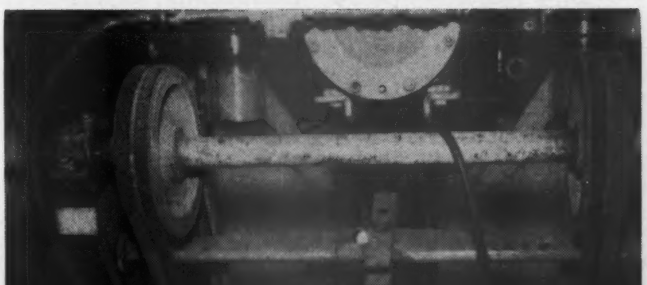
The eccentric crank is placed in its approximate locotion on the crank pin by lining up the bolt holes, and the drivers are revolved by an electric-motor drive. This revolution of the drivers measures the throw of the eccentric crank on the gauge which is mounted on the guide. The distance is indicated by two metal markers which are engaged and moved by a projecting member on the simulated crosshead which fits between the two moveable markers. The projection engages the marker farthest from the driving wheels on that portion of the revolution in which the crosshead is moving away from the drivers. The marker is pushed as long as the crosshead is moving in this direction. When the crosshead direction reverses the flat-surface contact is broken and the marker stays in its furthermost position. The rear marker is placed at the other end of the stroke in a similar manner when the crosshead is moving in the opposite direction. The distance between the two markers indicates the throw of the eccentric crank.

With the markers in the positions given them by the movement of the crosshead, the moveable ruled metallic strip is lined up so that the zero mark, which is at the end of the ruler farthest from the drivers, lines up with the far marker. If the eccentric crank throw is correct the rear marker will then line up with a line which is marked for each class of locomotive and which is a distance away from the zero line equal to the correct crank throw.

Where the throw of the crank, determined by the marking on the gauge, exceeds the amount prescribed for the valve travel of the particular class of locomotive being checked, the pin end of the crank is moved toward the center of the driving axle; where the throw is too little,



A pair of drivers being checked for correct location of the eccentric crank on the eccentric-locating machine—The heavy counterweight shown on the crankpin is used to even the load on the electric drive motor throughout the revolution of the drivers



The drive and the clamping mechanism of the eccentric-crank locator—The end of the primary drive shaft, which is belt driven from the motor, is shown where it connects to the lower shaft through a worm gear—The rubber-tired drive, one wheel of which can be seen at the left, clamps to the locomotive wheels by pivoting about the lower drive shaft—It is actuated by the scrap air pump, the lower half of which is visible

the crank is moved away from the axle center. The eccentric crank is moved on the crank pin and the check is then repeated until the eccentric crank has the proper throw.

With the eccentric crank properly located on the crank pin, keyways can be laid out and bolt holes drilled on new eccentrics, or bolt holes reamed and key adjustments marked on old eccentrics where the location was shifted. Where used eccentrics are shifted, existing keyways in

Close-up of the simulated valve crosshead and guide, showing the moveable gauge for checking proper crosshead travel

the crank pin and in the eccentric crank are not disturbed, all adjustment for relocation being made with an offset key. When new bolt holes are made, or when existing bolt holes have to be reamed because of adjusting the crank location, this is done with the drivers in place on the eccentric-crank locating machine. A radial drill press is mounted alongside of the locating machine to perform the drilling operation.

The locating arrangement is adjustable to accommodate the driving wheels of all classes of locomotives. The rod which takes the place of the eccentric rod has a universal joint near each end to take care of slight irregularities in the alignment between the drivers on the machine and the simulated valve guide. The end which fits the pin in the eccentric crank contains an adjustable opening so that the three rollers will fit snugly on any size pin. This adjustable bushing is composed of two semi-circles with a hinge arrangement joining them together at the pivot point; they are joined together opposite the pivot point by a bolt which increases or decreases the gap to enlarge or reduce the bushing opening. The small wheel crank located on the top of each guide moves the guide in and out in a direction parallel to the drive-wheel axle to align the extended center line of the guide with the eccentric crank pin. A large wheel on the center of the transverse supporting member for the two guides adjusts both guides simultaneously up or down so that they may be placed in the proper location relative to the center line of the driving wheels.

The drivers are revolved by four pneumatic rubber tires which are raised to position and held against the drivers by means of an air-cylinder. The tires are driven through V-belts and shafting in a step-down speed arrangement from an electric motor. The motor turns a shaft through a belt drive. This shaft in turn drives two shafts perpendicular to it, one at each end, through worm gears. On each of the second shafts are mounted two small pulleys which drive two large pulleys mounted on the shaft to which the rubber-tired driving wheels are fastened. The load on the motor is equalized throughout each revolution of the drivers by a counterweight hung on each crankpin.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Removing Oil

Q.—What methods are employed for removing excessive amounts of oil from the inside of a locomotive boiler? Is a regular washout sufficient? E.K.R.

A.—Excessive quantities of oil can be removed from a locomotive boiler by boiling. This is done by removing the dome cap and filling the boiler with two gauges of warm water, and applying 150 to 250 lbs. of Paige-Jones chemical No. 81 or No. 84 through the dome cap opening. The quantity depends on the size of the boiler to be cleaned. Apply a steam line to the front mud-ring corner washout plug hole and allow the steam to heat the water for five hours. Then apply a warm water line to the blow-off cock and allow the water to overflow through the dome cap opening for three hours. The water line should be choked to at least a 1½-in. diameter. Drain and give the boiler a washout.

Reporting Alterations

Q.—Will it be necessary to file an alteration report, when removing four boiler tubes? These tubes are the outside tubes of the two top rows, there being two tubes removed on each side. The tubes are being removed to eliminate trouble experienced with the front tube sheet cracking at the tube-sheet knuckle, the cracks extending to the tube holes. A.R.F.

A.—When any repairs or changes are made, which affect the data shown in the specification, a corrected specification or an alteration report properly certified to, giving details of such changes, shall be filed within 30 days from the date the repairs or changes are completed. Removing four tubes would affect the data shown on the specification cards giving the number, diameter and length of tubes. Removing four tubes along the top row of tubes could increase the tube sheet area supported by the tube sheet braces, and thus increase the stress on the tube sheet braces affected. This stress is shown on the specification card and any change in this stress should be reported.

Tinned Staybolts

Q.—Is it a practice to tin staybolts to prevent staybolt leakage? F.E.M.

A.—The tinning of staybolts as a means of preventing staybolt leakage is mentioned in a paper entitled "Boiler Practice and Material Specification" by S. E. Christopherson published in the 1947 Proceedings of the Master Boiler Makers' Association. Mr. Christopherson said, "The tinning of staybolts to reduce leakage was tried on a Hudson-type passenger locomotive carrying 285-lb. pressure with considerable success. The tinned staybolts were applied to the left side sheet while staybolts to the right side sheet were applied in the usual manner. The following method was used. Staybolts after being threaded were dipped in full strength muriatic acid for about 30 seconds, then removed and shaken to remove the acid. They were

then dipped in cut acid (muriatic acid cut with zinc). After being cleaned in this manner, they were ready for tinning. Virgin tin at 650 deg. F. was used. The entire staybolt was immersed for approximately five minutes until properly tinned. The staybolts were removed, shaken to remove the surplus tin and were then ready for application. After approximately 50,000 miles of service there are about 40 leaky staybolts in the right side and none in the tinned side."

Monon Dedicates New Diesel Repair Shop

On March 23, the Chicago, Indianapolis & Louisville dedicated with appropriate ceremonies a new Diesel repair shop at Lafayette, Ind., which is designed to accommodate both servicing and heavy-repair operations on Diesel locomotives at present comprising about 80 per cent of Monon motive power. Diesel inspection and fueling facilities currently used at South Hammond, Ind., Indianapolis, Ind., and Louisville, Ky., will be continued in service, but Diesel maintenance work for the railroad as a whole will be concentrated at the new shop which is being equipped to handle all operations except heavy motor and generator repairs.

The new shop, built at a cost of about $200,000, occupies a space of 170 ft. long by 65 ft. wide in the west end of the Lafayette locomotive shop. It includes two three-level inspection tracks, spaced 22 ft. on centers and long enough to accommodate a three-unit Diesel locomotive on each track. The forward unit of each locomotive extends into the old erecting shop where it may be lifted, if necessary, with a 200-ton crane and moved transversely to any track in the erecting shop. Additional crane facilities are supplied by a 15-ton auxiliary crane travelling underneath the main crane in the erecting shop and a 10-ton crane in what was formerly the machine shop.

One of the two three-level inspection tracks at the Monon's new Diesel repair shop, Lafayette, Ind.

Diesel locomotive trucks are removed by means of a drop pit in an adjoining track which extends through the erecting shop and gives access to a transfer table at the north side of the shop building. A Whiting 50-ton drop table is still to be installed on another track to permit dropping individual wheels without tying up other equipment in the shop.

The new Diesel shop itself is built in accordance with the latest ideas for this type of repair facility. A pit extending the full length under each locomotive is 4 ft. deep measured from the rail top. This permits readily inspecting and working on underneath parts. The floor level on each side of the locomotive is 2½ ft. below rail top which is a convenient height for working on truck sides, journal bearings, springs, etc. The side platforms, which give access to the locomotive cabs and enginerooms, are 4 ft. 8 in. above the rail top.

On the same level as the side platforms is an extensive enclosed floor space, accommodating a stock room, foreman's office, wash room, parts reconditioning room and filter cleaning room. Storage space for heavy materials and parts is provided on the lower level adjacent to the inspection pits.

Colored oil, steam, water and air pipes, and electric outlets are installed for maximum convenience in servicing and working on locomotives. Excellent daylight conditions on the upper platforms are supplemented as necessary by electric light and special fixtures built into the undersides of the platforms and into the pit sides thoroughly illuminate the lower parts of locomotives under all conditions. A bright color scheme has been used in finishing the interior of the Diesel shop.

Tellurium-Graphite Use in Foundry Work

The addition of tellurium and graphite to the molten mixture in grey-iron foundry practice has been found to improve the type of casting in which it is desired to combine a hard surface for wear with a grey-iron interior for strength and resistance to impact. The tellurium-graphite treatment serves to narrow the mottle zone between the hard-surface iron and the strength-possessing interior iron by creating two opposing forces within the mold. In this way, the width of the mottle zone of iron having properties between those of the surface metal and those of the interior iron is kept to a minimum. As a result the hard wear metal can extend to the depth fixed by the wear limit while the casting will possess a maximum amount of grey-iron backing-up metal to give the casting increased strength and resistance to impact. The tellurium-graphite treatment is applicable to grey-iron foundry practice in general; the possibilities it offers for substantial improvement in finished castings are exemplified by the substantial role it has played in the development work of the Association of Manufacturers of Chilled Car Wheels and its member companies which has resulted in a reduction of wheel failures by over two thirds among the wheels which have been cast during the past ten years.

Tellurium and graphite are introduced into the mixture of iron and carbon in which the carbon is combined chemically with the iron in the form of iron carbide, which, upon cooling is intensely hard but comparatively low in ductility. As the mixture of iron and carbon in

the form of iron carbide cools, one of three things can happen, depending on the length of time the iron carbide remains in the molten state. Where the metal is cooled rapidly, iron carbide is retained because the chilling takes place too rapidly for the carbon to precipitate out in the form of graphitic carbon. Deeper into the mold, where, during solidification, the cooling rate is slow enough to give the carbon sufficient time to precipitate out of the iron-carbide mixture as graphitic carbon, grey iron forms. Between these two limits of cooling rates a mottle zone is formed where the cooling rate is too fast to allow the carbon to separate out but too slow to allow the retention of iron carbide.

The tellurium-graphite treatment increases the sensitivity of the iron to differences in cooling rate in the manner shown by the following example: Assume a mixture of iron and carbon in such proportions that a cooling rate of 18 deg. per min. or less produces grey iron while a cooling rate of 60 or more degrees per minute produces the hard iron carbide. At any rate of cooling more than 18, but less than 60 deg. per min., mottle iron will be produced. The addition of a given amount of tellurium and graphite to the same iron-and-carbon mixture will narrow this temperature gap between the two cooling rates.

Hard metal can now be produced when the cooling rate is 40 or more degrees per mainute and grey iron when the rate is less than 30 deg. per min. With tellurium and graphite, therefore, mottle iron will be produced only in that section where the cooling rate is between 30 and 40 deg. per min., rather than between cooling rates of 18 and 60 deg. per min., as occurred without the treatment. Consequently, hard, wear-resistant metal can extend to the condemning limit for wear with a minimum reduction in the amount of grey iron backing, resulting in a casting with both maximum wear and strength properties. The width of the mottle zone can be kept at the minimum width required to separate the two types of iron with the dissimilar physical properties.

The decrease in the zone of demarcation between the iron carbide and the grey iron is achieved by the tellurium and graphite creating two opposing forces, one force acting as a hardening agent and the other force as a softening agent. Tellurium is the hardening agent. Its addition to the molten mixture during solidification helps to keep the iron and carbon in the combined form of iron carbide. Graphite, on the other hand, with which the mixture is innoculated, serves as a softening agent by helping the carbon to separate from the iron carbide in the form of graphite carbon.

The difference in cooling rates between the outside metal and the remaining metal in the mold is what permits these two opposite effects to occur within the same casting. When the metal is chilled rapidly the tellurium effect takes place because the solidification of the metal occurs too rapidly for the carbon to precipitate out as graphitic carbon. Deeper into the casting, where the cooling rate of the metal is lower, the graphite innoculation effect is stronger than the tellurium effect. In these areas the seeding of the mixture by the graphite in combination with the slower cooling rate causes the carbon from the iron and carbon mixture to precipitate out in the form of graphitic carbon.

Variations in the tellurium-graphite treatment can be used to compensate for iron that is harder or softer than normal or preferred. Where the iron has greater hardness than desired, the normal amount of tellurium is usually added, but an additional amount of graphite is put in. For soft iron additional tellurium is introduced while care is exercised to keep the graphite content practically constant.

Air Brake Questions and Answers

The 24 RL Brake Equipment for Diesel-Electric Locomotives—Parts of the Equipment—Locomotive A Unit

D-24—Control Valve (continued)

654—*Q.—What parts does the controlled emergency portion contain?* A.—(a) Controlled emergency double check valve piston, (b) the diaphragm, (c) the ball check *192,* rubber seated check valve *193* and spring.

655—*Q.—What are the duties of the controlled emergency double check valve piston?* A.—It controls the flow of air to the diaphragm and regulates the rate of brake cylinder pressure development during automatic emergency application in accordance with the K2 Rotair valve handle position.

656—*Q.—What does this provide for?* A.—A fast (non-controlled) build-up of brake cylinder pressure on short freight trains and passenger trains.

657—*Q.—How does the diaphragm function?* A.—Restricts the rate of locomotive brake cylinder pressure build-up to that provided by a choke to produce a controlled application during an automatic emergency brake application on long freight trains with the K2 Rotair valve in control position,

658—*Q.—What is the purpose of the ball check and rubber seated check valve?* A.—The ball check and rubber seated check valve with the spring *194* permits release in case valve *199* is held to its seat and prevents bypass of choke *181* during an automatic emergency application with the K2 Rotair valve set in control position.

659—*Q.—What parts does the dead engine cock and check valve portion contain?* A.—Main reservoir check valve and spring choke *Z* and the dead engine cock.

660—*Q.—What does the main reservoir check valve permit?* A.—It permits charging of main reservoir on a locomotive hauled dead in a train.

661—*Q.—What does this check valve prevent?* A.—It prevents back flow to the brake pipe.

662—*Q.—What does this insure?* A.—That the locomotive brake operates normally when applied.

663—*Q.—What is the purpose of choke Z?* A.—It permits charging of the main reservoirs on a dead locomotive at a controlled rate.

664—*Q.—Why should the rate of charging of main reservoirs be restricted?* A.—In order to prevent a brake pipe reduction which might apply the brake.

665—*Q.—What is the dead engine cock* (266) *used for?* A.—For cutting in and cutting out the dead engine feature.

666—*Q.—What parts does the independent application and release portion contain?* A.—(a) Small application and release piston *230,* (b) application and release piston slide valve *226,* (c) large release piston *237,* (d) quick release piston valve *253,* (e) automatic and straight air double check valve *250.*

667—*Q.—How does the small application and release piston function?* A.—Operates to provide independent release of the automatically applied locomotive brake when positioned in release position.

668—*Q.—What positions this piston in release position?* A.—The large release piston *237.*

669.—*Q.—In what position is the small application and release piston at all other times?* A.—In normal postion, *down.*

670—*Q.—What hold it in this position?* A.—At all other times the piston is held in normal position by main reservoir air which feeds down around the piston on top

of a piston packing cup on the lower end of the piston.

671—*Q.—In this position what other operation does it permit?* A.—As the application and release piston slide valve *226* is shouldered in the piston, it is so positioned as to permit straight air application, if this feature is included in the equipment.

672—*Q.—What holds this slide valve on its seat?* A.—Main reservoir pressure which is on top of this slide valve at all times.

673—*Q.—What is the duty of the large release piston 237?* A.—It moves small release piston and slide valve.

674—*Q.—What operates the large release piston?* A.—The *S-40-D* independent brake valve.

675—*Q.—When does this happen?* A.—When independently releasing the locomotive brakes after an automatic application.

676—*Q.—How does the quick release piston valve 253 function?* A.—Operates to provide a quick release of the locomotive brake.

677—*Q.—When does this movement occur?* A.—In independent release after an automatic application.

678—*Q.—Explain how this is accomplished?* A.—The air in the spring chamber above the piston is vented which permits the piston valve to be unseated, thus venting locally the relay valve air for a fast release of the locomotive brake.

679—*Q.—What normally holds the quick release valve seated?* A.—Spring *256* normally holds the quick release valve seated.

680—*Q.—How does the automatic and straight air double check valve function?* A.—To permit an automatic or straight air application. (The straight air is not used in this installation.)

681—*Q.—How does it function during an automatic application?* A.—The straight air check valve end is seated.

682—*Q.—How does the check valve operate during a straight air application?* A.—The automatic check valve end is seated.

683—*Q.—Describe the operation of the independent double check valve.* A.—It is the same as the automatic and straight air double check valve. It functions to seat the automatic and straight air check valve when an independent application is made and seats the independent check valve when an automatic or straight air application is made.

Questions and Answers On Locomotive Practice

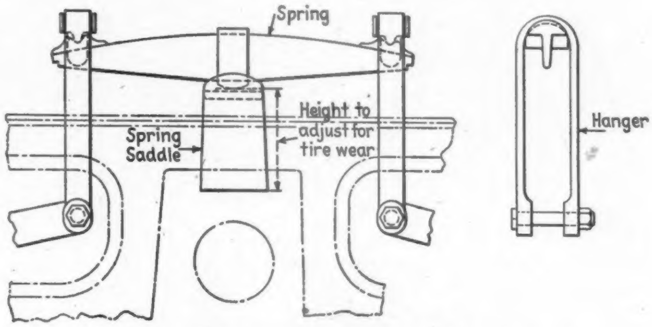
By George M. Davies

(This column will answer the questions of our readers on any phase of locomotive construction, shop repairs, or terminal handling, except those pertaining to the boiler. Questions should bear the name and address of the writer, whose identity will not be disclosed without permission to do so.)

Spring Hangers

Q.—What is the reason for using a loop or saddle type spring hanger on the driving springs of a locomotive? With the conventional spring hanger using a gib through the spring hanger it was possible to lace up the engine by applying heavier gibs. How is this done with the loop type hanger?—F.D.E.

A.—The loop type hanger, shown in the illustration, was developed in order to obtain clearance between the boiler and the springs. On modern power using large boilers with a limited overall height the clearance between the driving springs and the boiler shell became so small that it was impracticable to use the conventional hanger and gib. In order to obtain the necessary clearance between the springs and the boiler shell it



The loop-type hanger gives added clearance

became necessary to use reverse camber springs together with the loop-type hanger. Tire wear can be compensated for by either applying shims under the springs, or by applying spring saddles of increased height.

Colleges Specializing in Railway Mechanical Engineering

Q.—What colleges in the United States give evidence of having the best courses in the field of railroad locomotive design, maintenance and shop work? Would you know the qualifications for entrance in any of these colleges? W.J.D.

A.—Purdue University, Lafayette, Ind., and the University of Illinois, Urbana, Ill., have excellent courses in railroad mechanical engineering. The qualifications for entrance into any college can be obtained from the college catalogs which are generally available in your local library or can be obtained by writing to the registrar of the college.

Compensating for Crank Hub Wear

Q.—On our Mikado type locomotive we have considerable grooving in the crank hub of the rear driving wheel where the side rod bushing wears into the hub face. In making repairs to the hub face is it necessary to machine out the crank face hub and apply a steel liner in order to bring the hub back to its original thickness? F.B.K.

A.—The practice of applying a ¼-in. thick steel liner into the crank pin hub to compensate for wear is an old one. The present practice on cast steel wheel centers is to build up the worn face with electric weld and remachine the hub to its original thickness.

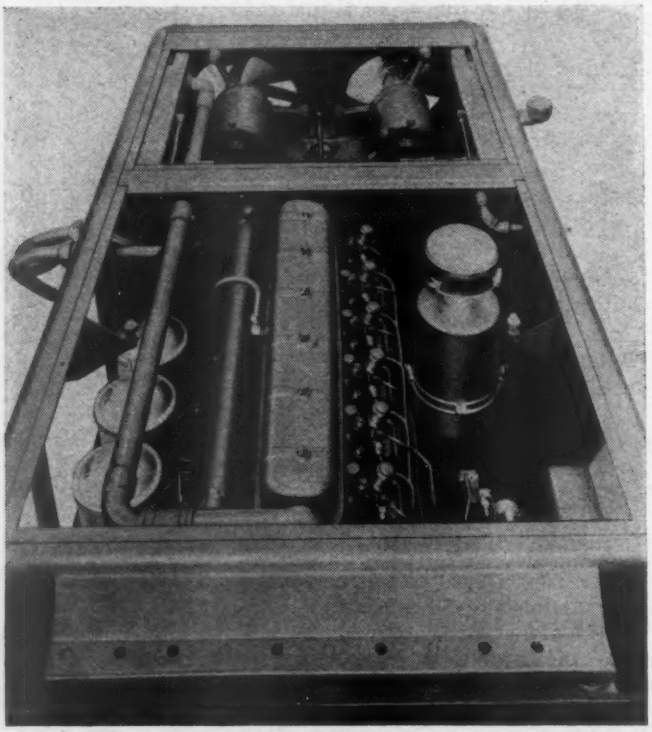
Sand Pipes

Q.—The I.C.C. rules state that each locomotive unit shall be equipped with proper sanding apparatus which shall be tested before each trip and that sand pipes shall be securely fastened and arranged to deliver the sand on the rails in front of the wheel contact. Does the term pipe in this rule mean commercial pipe? Is it permissible to use a rectangular-shaped duct in place of the conventional commercial pipe outside of the jacket? F.E.M.

A.—I do not believe it is the intent of the commission to restrict sand pipes to the use of commercial pipe. The term sand pipe is the accepted name of the means used to deliver the sand from the sand box to the rail. Many of the modern locomotives use metal ducts of various shapes under the boiler jacket with either commercial pipe or tubing being between the jacket and the rail.

A. C. Power System for Trains

Fluid couplings between engines and generators permit automatic synchronizing and make a network of the train power supply system



Top view of a Waukesha Diesel-alternator cabinet showing engine and generator compartments—Electric fans in generator compartment drive ventilating air through the engine radiator and over the alternator's heat exchanger cooling system

THE Railway Division of the Waukesha Motor Company, Waukesha, Wis., has developed a power unit for mounting on passenger cars which consists of a Diesel engine driving an alternating current generator which can be trainlined with other similar power units on other cars. Trainlining with a.c. machines requires synchronizing and this is made possible without complicated control equipment by placing a fluid coupling between the engine and the generator. It is only necessary to close the switch between two generators. The couplings automatically adjust for phase displacement and after the generators are running together, the couplings compensate for momentary angular displacements so that the machines will not fall out of step. With this arrangement one car may borrow or lend power to another car, and all power plants need not always be running. Under conditions of light load, some may be removed from the train. This allows for more flexible maintenance schedules.

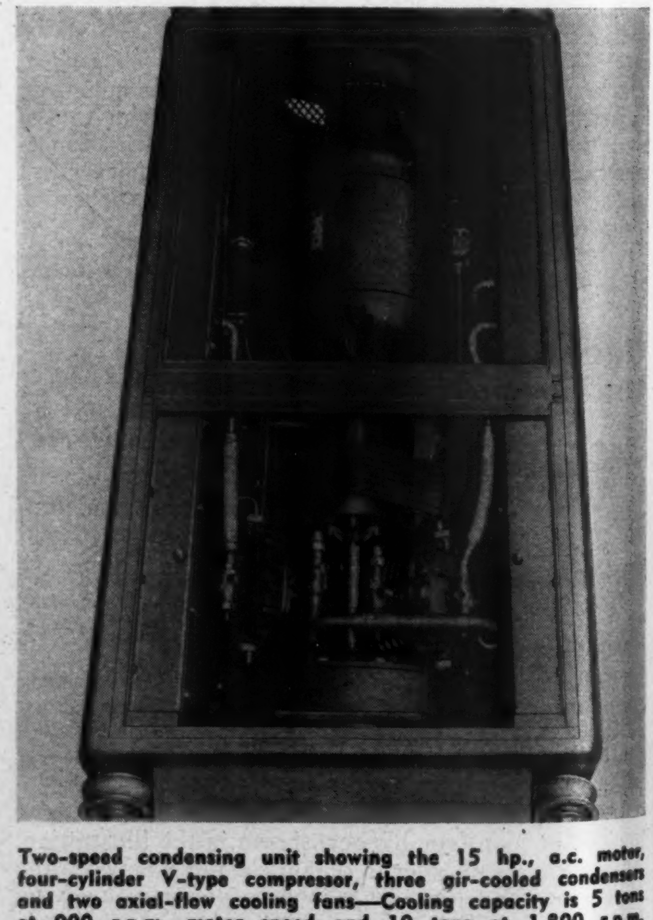
The system will supply electrical energy for the operation of air conditioning, lighting, fans, water coolers, winter heating, electric blankets, and all electric service needs which do not involve the actual motive power.

The power units consist of a six-cylinder, four-cycle, vertical Diesel engine, coupled to an alternating current 220-volt, 60-cycle, 3-phase alternator of 31.25 kva. capacity, and driven at engine speed—1,800 r.p.m. A companion package for air conditioning consists of a four-cylinder refrigerant condensing unit of 5-10 tons' capacity, driven by a two-speed, a.c. motor.

With complete Waukesha equipment each car is an independent unit so that any car may be set out or in, and still maintain all air conditioning and other electric services without outside aid, and without power interruption to any other cars in a train.

No Terminal Charging Facilities Required

Heavy capital investment in station or terminal facilities for battery charging to maintain the air conditioning



Two-speed condensing unit showing the 15 hp., a.c. motor, four-cylinder V-type compressor, three air-cooled condensers and two axial-flow cooling fans—Cooling capacity is 5 tons at 900 r.p.m. motor speed and 10 tons at 1,800 r.p.m.

Two-speed condensing unit with control and tester's cabinets open

or other electric service within the car is made unnecessary. The independently powered car can also maintain all electric services at full efficiency, whether the train is in motion or standing, whether the car is set out or is maintained in a consist, and without penalizing the motive power. Cars can be pre-cooled or pre-heated wherever they may be, as long as there is Diesel fuel in the supply system.

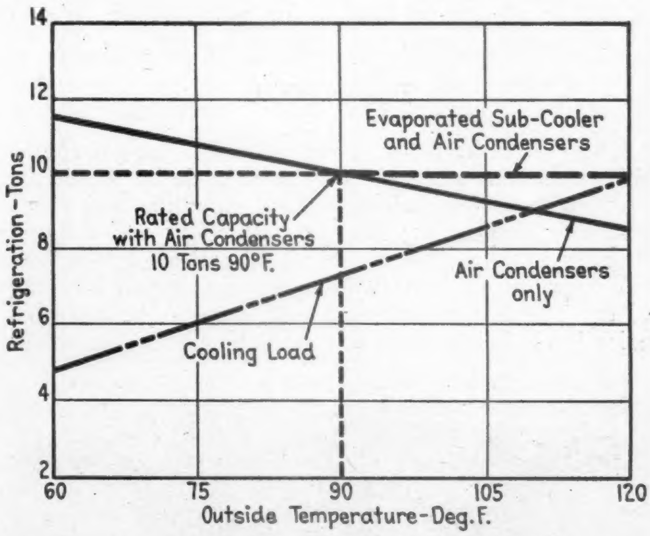
Parallel Operation

The fluid drive couples the engine to the generator, and provides the flexibility which permits the generator being "brought in," to step ahead or move back to synchronized position even though this may be as much as 180 deg. out of phase when the line switch is closed. The engine governor and electric speed co-ordinator controls the frequencies of units to be paralleled so that the operator has but one switch which can be thrown at will when parralel operation is desired.

This simple synchronizing operation offers some unique advantages, as it permits train-lining of cars so that in case of emergency or exceptional heavy load conditions power may be borrowed or loaned from car to car through the train. For average operating conditions, connecting plugs and receptacles of 150-amp., 250-volt capacity, with three-wire cable jumpers, are adequate for trainline connections.

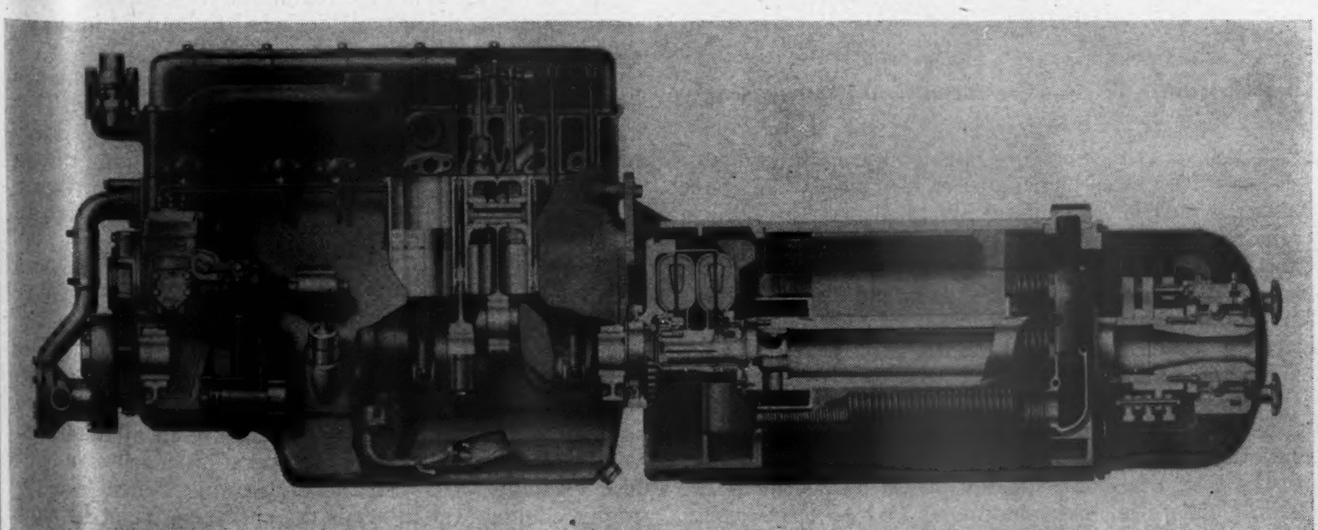
The system thus has practically all the advantages of head end power without the latter's chief limitation—the inflexible and fixed train consist.

In train line operation each car becomes an element in a power grid or network, which inherently increases service reliability, for instead of depending on two or possibly three large units in a head end power car, the electric load is shared by the entire group throughout the train, and single engine or generator failures do not



Performance curve showing the capacities obtainable from the 5-10 ton electric two-speed condensing unit, and the added capacity when the automatic evaporative sub-cooler is employed

cripple or cut the electric services. Under normal operating conditions even one-third of the power units may be "out," and yet the remaining units could supply power sufficient for full-load performance on all cars.



Sectionalized view of the Diesel alternator showing the fluid drive which couples the engine and generator

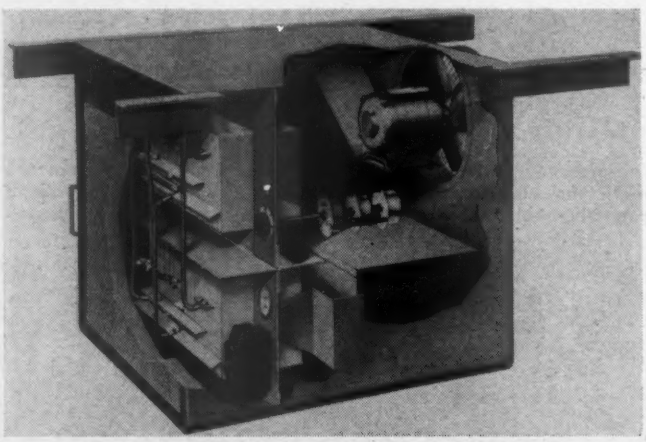
Improved Economy and Better Maintenance Schedules

Improvement in operating economy may be effected during off-season or between-season use. At such times when there is little or no call for cooling or electric heating, the remaining load is so light that one power plant may serve a number of adjacent train-lined cars. Operating at or near its full rated capacity, the economy both in fuel and maintenance of the well loaded unit is at or near its optimum, a condition rarely possible, even if the head end power is furnished and divided by as many as four engine-generators.

Another advantage claimed for the system is the greater flexibility in the planning and execution of routine maintenance and shopping operations. During the off-season a greater number of power plants can be removed and shopped for annual overhauls than would be possible if train-lining were not possible or were not employed. Major overhauls can be scheduled on a more leisurely basis without overtime—an appreciable economy not possible when units must be rushed through to prevent or reduce the lay-up time of an entire power car and the revenue equipment which the units serve.

Power Plant

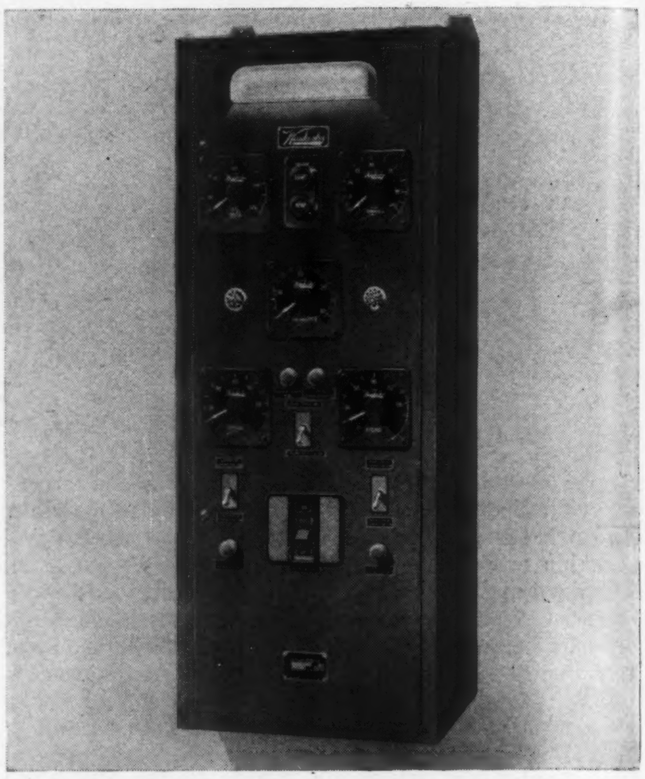
The Diesel-alternator power plant, like the gas engine air conditioning and generator units made by Waukesha Motors, embodies under-car track mounting and shock absorbing suspension; flexible connections and roll out features to permit routine servicing and inspection with full operation in the rolled-out position; sound silencing of the engine compartment, which keeps the recorded noise levels below the usual station or terminal levels; axial flow, quiet type cooling fans for the engine radiator.



Selenium rectifier for alternator excitation and battery charging

The entire power plant is assembled in a welded steel chassis, which is 77 in. long, 39 in. deep, and 27½ in. from car sill to bottom, and weighs, without mounting tracks, 2,500 lb. As it is a complete independent power package with quick-detachable couplings for fuel, exhaust, and electrical connections, it can be removed, replaced or exchanged, with little time and effort.

The six-cylinder, four-cycle Diesel engine is of compact design to permit under car installation within N. Y. C. clearance limitations, and still maintain its conventional vertical operating position. The bore is 3¾ in., the stroke is 4 in., and the piston displacement 265 cu. in. At its normal operating speed of 1,800 r.p.m., it develops 60 hp. American Bosch injection equipment is employed throughout with single orifice, pintle type nozzles, injecting the fuel into a controlled turbulence combustion chamber.



Diesel-alternator control panel for installation in the car locker

A special feature of this power plant is the engine governor built into the fuel pump control, but responsive to the frequency of the electric output rather than the fluctuation in engine speed alone. This combination of electric and mechanical control compensates for the fluid coupling displacement so closely that the frequency is maintained within one-half cycle. Flickering of lamps or other manifestations of variation in running speeds are eliminated even with the extreme variations of load that result when the 15-hp. air conditioning motors are thrown on or off.

Smoothness of operation is, in large measure, due to the heavy, four-bearing, counter-balanced crankshaft with its torsional vibration dampener, and the accurate balancing of rods, pistons, and other reciprocating parts. The crankshaft bearings, both mains and pins, are hardened to 600 brinell to insure long life. Both rod and main bearing shells are the renewable steel backed copper-lead-babbitt precision type, designed to be used in heavy-duty service.

The wet cylinder sleeves are completely surrounded by the coolant, and are easily removed for renewing. They are individual alloy castings heat-treated to a brinell hardness of 400, and together with the aluminum pistons and chrome-plated top piston rings, they form a combination which insures a maximum of life to these vital parts.

Chrome nickel intake and exhaust valves are mounted in alloy iron valve guides pressed into the single piece alloy iron cylinder head. Exhaust valve seats are Stellite inserts.

Lubrication is accomplished by pressure, and intermittent, directed spray to every moving part. To insure uniformly adequate engine temperature in all weathers, whether or not the engine is in operation, a self-contained heat exchanger between the car heating system and the engine cooling system keeps the entire engine at its most efficient operating temperature, and insures instant starts at all times. Fuel tanks also have a steam heating coil

connected to the car heating system to prevent cold weather congealing of the Diesel fuel. The conventional, heavy duty, 32-volt or 64-volt electric starter with automatic pinion engagement to the heat treated ring gear on the engine flywheel is controlled either from the car locker push button or from the test button in the control box on the unit itself.

Connecting the alternator to the Diesel engine is a fluid coupling which plays a major role in simplifying the paralleling of alternators. By taking advantage of the complete flexibility of this type of drive, not only is it possible to throw the alternators on or off the train-line by simple switching contactor controls, but the fluid coupling also acts as a perfect cushion to effectively "swallow" shock effects of all kinds between the engine and alternator. The simplicity of this drive with no mechanical connections, belts, or fast-wearing parts, makes it the most economical to maintain as well as the smoothest to operate.

The alternator is of special interest because of the original design of its heat exchanger cooling system. To meet the severe service requirements encountered in railway operation—complete protection against dust, moisture, and the elements—and still retain moderate dimensions, the alternator is fully enclosed with a constantly recirculating internal air steam passing from end to end over the brush and slip ring assembly, through the windings and the hollow armature shaft. The heat picked up en route is then dissipated through the walls of the corrugated external cooling ducts which lie outside the generator frame and in the path of a continuous blast of outside aid. With the ducts' large radiating capacity, the air within—not mixed with outside air—is rapidly cooled, and returns in the closed circuit to the slip ring end of the generator and repeats the cycle. The alternator coils are form-wound throughout, and the insulation characteristics meet or exceed Class B requirements.

Selenium Rectifier Excitation

To simplify the alternator design with a corresponding increase in reliability, separate excitation by an air cooled selenium rectifier and battery is employed. The rectifier is suspended beneath the car. It has sufficient capacity to charge batteries required for engine starting, controls, and emergency lighting, in addition to furnishing the current for the alternator excitation. If desired, more than one rectifier may be used, and the two operated in parallel when unusual demands for direct current service exist. Forced ventilation is provided by a motor-driven fan mounted in the rectifier casing. A filter is employed to remove dust and water from the air stream.

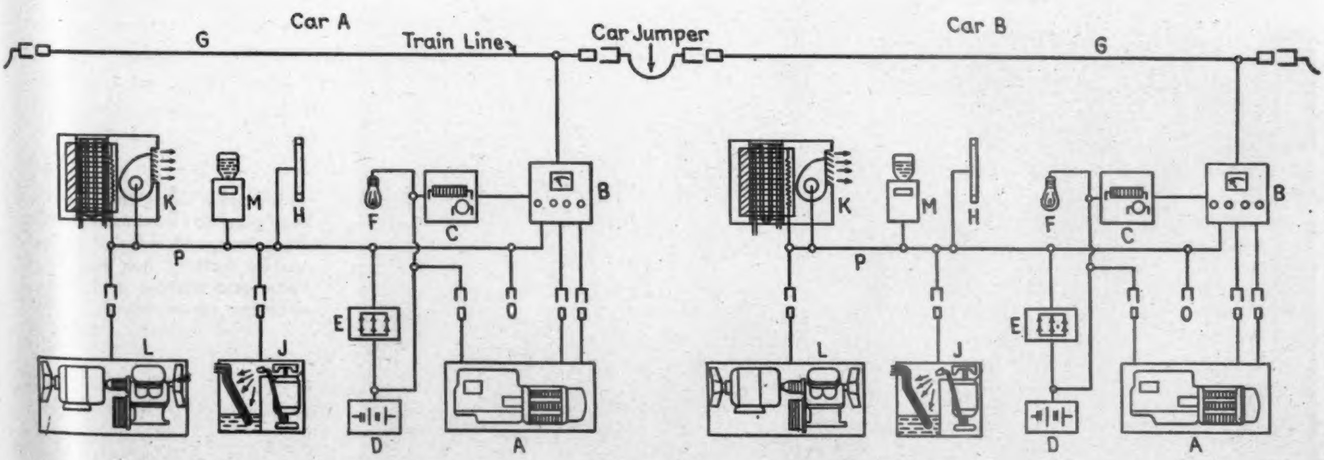
Two-Speed Condensing Unit

A 5-10 ton two-speed electric drive condensing unit for air conditioning serves as a companion unit of the same size and general appearance as the Diesel alternator. It is powered by a 15 hp., 220-volt, 60-cycle, 3-phase, a.c. motor. Depending upon cooling demand and refrigerant pressure, it operates at either 1,800 or 900 r.p.m., providing either 10 or 5 tons refrigeration cooling capacity. The speed is controlled by external switching of the motor field circuits.

The compressor is a four-cylinder V-type unit which has long been standard on Waukesha ice engines. It is entirely self-contained with sealed-in lubricant and air-cooled cylinders. In the two side panels of the chassis are three large air-cooled condensers through which air is drawn from the outside, and discharged from each end, by two axial flow fans within the motor and compressor compartment. The fourth panel is a water-tight locker containing the switch contactors and service tester's controls. This unit like the Diesel alternator, is mounted on roll-out tracks suspended beneath the car, with rubber shock and vibration absorbing elements in the suspension trolley. Flexible refrigerant connections, as well as electric leads, permit this unit to be withdrawn from beneath the car for convenience in servicing. In the same manner as the Diesel alternator, it may be operated in its rolled-out position.

Running at the low speed, and with air condensers, the unit has a capacity of five tons. When the cooling demand increases, it automatically changes to high speed operation. When operated with air condensers only, it has a capacity of 10 tons at 90 deg. F. outside temperature. With an evaporative sub-cooler, this 10-ton capacity is maintained up to at least 120 deg. ambient temperature.

(*Continued on page* 92)



(A) Engine Driven a. c. generator
(B) Control panel (locker)
(C) Generator voltage regulator
(D) Battery
(E) Rectifier-Battery charger
(F) Emergency lighting
(G) Train line
(H) Fluorescent lighting
(J) Evaporative sub-cooler
(K) Evaporator and electric strip heaters
(L) Electric condensing unit
(M) Water cooler
(O) Receptacle for a. c. stand-by supply
(P) Car line

Schematic diagram of a Diesel-power supply and air-conditioning system for railway passenger trains—Two cars are shown connected in parallel by a train line connector

Care and Maintenance of

Railroad Storage Batteries

By R. I. Fort*

There are only a few basic requirements, but their fulfillment under present day operating conditions demands good engineering and closely controlled maintenance

STORAGE batteries are definitely necessary to railroad operation, and the problems of adequate battery maintenance have recently been greatly accentuated by the tremendous growth of electrical loads on passenger cars. The storage battery has important duties on a passenger car. It must supply electrical power when a car equipped with an axle generator is standing, or running slowly. On cars having internal-combustion engine-generator equipment, it must be available for engine cranking and standby service, also emergency power in case of failure with either type equipment.

In the past 15 years, connected loads on typical coaches have grown from about 1 kw. to as high as 20 kw. Dining, lounge and other special cars may have loads of 25 or 30 kw. and if electric cooking is added, the total may run from 45 to 60 kw. These loads represent improved service to the passenger directly or indirectly. Some items in the direct category are increased illumination, better air conditioning through larger cooling equipment, increased air circulation, air sterilization and improved air filtering, and entertainment (radio, recordings, etc.). Some of the more indirect items are reduction in time, labor and facilities for re-icing cars through use of mechanical refrigeration, greater comfort and safety from wheel-slide control and journal-temperature warning devices, and reducing congestion in kitchens and pantries.

Batteries Represent a Large Investment

In an effort to provide sufficient capacity to handle these loads for as long a time as possible to meet abnormal operating conditions, batteries have grown from about 7 kw.-hr. to around 35 kw-hr. This increase in battery size could not keep up with loads, however, as definite weight and space limitations were encountered. The result was a compromise, a lowering of the formerly accepted standard of eight hours' capacity from the battery until today, many cars are able to operate only two hours or even less without help.

A typical major railroad will have some thousand or so batteries ranging in size from 150 to 1,250 amp.-hr. capacity, consisting of from 6 to 90 cells each. This represents quite an investment in terms of dollars and, considering the serious consequences of lack of, or poor, maintenance, calls for a well-planned program to protect and extend the useful life of that investment. Battery manufacturers are only too glad to cooperate in setting up instructions for daily and periodical attention to batteries in the yards and to assist in laying out shopping procedure and facilities. That is the

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Maintainer using the flushing gun to wash off dirt from tops and sides of cells—The battery box has an open grid bottom and split door for convenience

Flushing done correctly and at the proper time is essential to good performance and long battery life.

easiest part of the program. The more difficult and everpresent part is to coordinate the work of various terminals to insure proper attention to each battery without overloading any one terminal.

Use of Card Records

Most maintenance programs are based on a card carried in each car, and the results obtained vary directly with the accuracy of the information thereon, and with the follow-up of that information on terminal, divisional and system levels. A typical card will have space for identification of the battery, last date shopped, and last date flushed. Cards are usually good for one month, and have lines for each day of the month with columns for voltage test, ground test, solution height, specific gravity, hours charged, remarks, location, and perhaps initials of maintainer. At the end of the month, certain pertinent data are transferred to a new card and the old one turned in to the foreman. It is a lucky foreman who is allowed time and clerical help to go over these cards. It takes only a few hours a month, but the foreman can derive much valuable information from the cards as to performance of equipment and his men, and is in a position to make immediate changes and adjustments to correct poor conditions. The cards from all over the system are then gathered in the office of electrical engineer where they can be sorted, reviewed and filed. Again, it is a fortunate railroad that provides clerical help to do this work properly and consistently. It takes only a few days each month, but is a source of very valuable information on performance of equipment and effectiveness of the maintenance forces and overall program.

The daily maintenance procedure at a terminal generally falls into a pattern. On arrival, the car is given a quick check to determine that the car came in with generator working and battery reasonably charged. At the coach yard, the maintainer checks the car card. A quick glance gives him the recent history and performance, thus providing clues to impending trouble and also tells him of any periodical work that may be due. The battery is checked for obvious mechanical defects, cleanliness, grounds, solution height and state of charge. Whatever work is indicated, is performed and suitable notations made on the car card.

The statements immediately preceding seem very simple, but they cover a lot of hard, difficult and very important work. The short turnaround time allowed in present-day operation, coupled with the cost of labor, justifies considerable engineering to reduce the time and difficulties of maintenance. One line of endeavor, toward modifications in the generator regulator to produce even the exact water consumption in the battery, has resulted in a double gain. A flushing period of from 60 to 90 days for a lead-acid battery, or around 30 days for the nickle-alkali battery, results not only in less work but extends the life of the battery.

The line of demarcation between harmful continued under charging and disastrous overcharging of a battery is very narrow. The usual method of controlling this is by means of the generator-regulator voltage adjustment. With the increased use of large generators and bigger, more compact batteries, the internal-temperature-charging-voltage characteristic of a battery is becoming more important. Work is under way to determine the effectiveness and practicability of battery temperature compensation of the generator voltage-regulator adjustment. Improved ventilation to carry away the internal heat produced in the battery is another forward step.

Flushing

Dirt, sometimes assisted by overflushing or boiling because of overcharging results in battery grounds. Battery grounds, even leakage grounds, cannot be tolerated with the multiplicity of sensitive relays for cooling and heating control, brake control, communication equipment, etc., on a car. Grounds are a symptom of poor maintenance but the answer is not always in raising blisters on the maintenance forces. Improve-

ments and closer attention to generator regulator adjustment will practically eliminate boiling and reduce the frequency of flushing. The last, plus proper equipment and decent headroom for flushing, will reduce overflushing. Last, but not least, careful design of the battery box to reduce incidence of dirt and make it easier to clean out the dirt that does accumulate is indicated. The recent development of a means for easily rolling an entire battery out from underneath the car to permit ready maintenance offers considerable promise.

The quality of water used for flushing batteries must not be overlooked. Many cities have tap water which is satisfactory for use in batteries. However, periodical tests must be made as the water can and does become unsuitable at times. At places where the water contains detrimental impurities, other arrangements are necessary. Do not forget that cleanliness of water handling equipment is important as otherwise the effectiveness of additional expense for pure water is voided.

Efficient Use of Personnel

A very important factor in maintenance of car batteries previously mentioned is that of adjusting the generator regulator. Generator regulators, if properly set and given reasonable attention, should go long periods of time without further adjustment. Occasions arise when a regulator should be readjusted, however, and this is not always an easy matter. The usual method of sending a man out to ride the car in service and make adjustments en route has given good results for many years. It is not always satisfactory, as location of the regulator may result in disturbance to passengers and crew, it may run into considerable expense from wages, and there is the loss of regular work if the man is taken from the terminal maintenance force.

Other means of setting regulators in the yard include small portable motor generator sets, disconnecting the regular drive and attaching a portable motor large enough to operate the generator and use of standby motor on cars which have such motor permanently connected to the axle generator. In all cases, it is important on many regulators that sufficient time be allowed for the regulator to reach normal operating temperature as this may have an appreciable effect on the final adjustment.

Engineering

Another very important factor in the life of storage batteries is that of yard charging. If the original design of the car equipment is carefully engineered as a whole, selecting the right battery size and generator size for the connected load, there is little need for yard charging. Such design is not always possible or practicable considering the many factors entering into the problem. Space and weight limitations, operation (ratio of standing to running time en route), very high loads, use of power during layover periods, such as lights for cleaning, refrigeration equipment, testing and adjusting, all have to be considered and may require frequent yard charging. Even cars with a well balanced design may require yard charging at times, because of some unusual operating condition or failure.

Yard charging equipment can be quite expensive, both in the initial investment and in the subsequent loss of battery life due to abusive overcharging if not properly handled. A very extensive study of yard charging equipment was made some years ago by a committee of the Electrical Section, Engineering Division, A.A.R., which lists the different equipments and arrangements available, and the advantages and disadvantages of each. Every terminal is a separate problem, and the choice of a given system will vary according to local conditions, but by all means give due consideration to proper control of charging rate and time.

Diesel and Truck Batteries

Another very important use of storage batteries on railroads is on Diesel locomotives. The problems of maintenance are very similar to those on passenger cars with possibly two major exceptions. First, the practice of connecting the negatives of several batteries together through the negative control wire on multiple-unit locomotives requires even closer control of battery grounds. Second, the load duty of a Diesel battery is less severe than on passenger cars. The battery is less apt to be discharged, and its normal service approaches that of a standby battery on floating charge. This is particularly true if provision is made for outside power to the lighting circuits during layover and maintenance periods. Adjustment of voltage regulators is much more convenient, in fact there is little excuse for overcharging a Diesel battery.

Other applications of storage batteries used by a railroad mechanical department include battery trucks for material handling. The methods of charging and maintaining these batteries have been well worked out in the many industrial applications of such equipment and railroads have a wealth of experience.

Maintenance of storage batteries on a railroad presents many problems and headaches, but the size of the investment justifies considerable expenditure to protect that investment. The aim of a maintenance program is to secure dependable service from the batteries at the least expense and boils down to only three essentials:

Keep the batteries clean.

Maintain solution at the proper level.

See that battery is kept to a proper state of charge.

A. C. Power System for Trains

(*Continued from page* 89)

The two-speed operation is necessary for maintaining humidity control under all conditions. Where a system has but one output and speed, which is under simple car thermostat control, the cycling of the condensing unit creates an unpleasant rise in humidity during the "off" periods. With the two-speed operation, the cycling periods are prolonged and the humidity remains more nearly constant, promoting passenger comfort.

Winter Heating

In winter operation, when the cooling unit is not needed, the Diesel alternator has available 15 to 20 kva. for electric heating that may be installed either in the air conditioning system, or in a liquid heat exchanging unit for floor coils. Provision can be made for additional heat by reclaiming the heat of the engine exhause through suitable heat exchangers, and, with a liquid heating system, electric emersion heaters can be applied for still further heating service. This offers possibilities of maintaining comfort temperatures by means of the power plant alone from maximum summer temperatures down to zero.

More Kw. Output from

Axle-Driven Generators

By B. A. Widell*

Four new motor-generator sets have been developed by the General Electric Company to meet power supply requirements of air-conditioned passenger cars

THE requirements of axle generators for air-conditioning and lighting of the more recently designed railway cars have been increased many fold. To meet these increased requirements, the General Electric Company has developed four new axle-driven motor-generators. This line has a much wider range of application than any previously offered in a common frame size with maximum number of interchangeable parts.

25-Hp., A.C. Motors

All of these motor-generators have a ventilated 25-hp., 220-volt, 3-phase, 60-cycle induction motor which is used at stations where a.c. power is available to drive the generator. The motor capacity is sufficient to supply d.c. power during the precooling period without excessive drain from the battery. The maximum continuous output of the generator when driven from the a.c. end is 15.5 kw. and 17¾ kw. respectively depending on whether cars are equipped with lead-acid or Edison-type batteries. The overall set efficiency when operating from a.c. end is between 75 and 78 per cent with a power factor of approximately 86 per cent.

Four Generators

The four types of motor-generators were designed for the following ratings when axle driven:

A 25-kw., 134-volt generator with a speed range of 780 to 2,470 r.p.m., which includes the additional capacity required for coaches or diners equipped respectively with 5-kw. and 6.4-kw. inverters. The inverter provides 3-phase, 220-volt, a.c., 60-cycle power at constant voltage and frequency for a variety of electrical devices, including fluorescent lighting.

A 20-kw., 37½-volt generator which can be applied to cover a speed range of 690 to 3,780 r.p.m.

A 31.5-kw., 75-volt generator which is applied on dining cars where the power load is appreciably greater than on coaches. The regulated full-load speed range on this generator is from 915 to 3,780 r.p.m.

A 20-kw., 75-volt generator which has a regulated full-load speed range of 690 to 3,780 r.p.m.

Both the 37½-volt and 75-volt, 20-kw. generators with their wide speed range fulfill a need in the lower-speed trains of full load cut in speed as low as 21.5 m.p.h. and yet do not exceed the maximum permissible speed of the generator at 107 m.p.h. when operated on high-speed trains. Obviously, there is a decided advantage from the operating and maintenance standpoint if all cars can use the same gear ratio in low- or high-speed service.

Self-ventilated axle generators with class B insulation are designed for current capacity ratings at 25 per cent above the full-load cut in speed on the basis of a 5-hr. heat run for 105 deg. C. rise by resistance on the armature and 120 deg. C. rise by resistance on the fields. In general short-run service, the generators will have to operate at loads considerably in excess of the 5-hr. rating to keep up the battery charge. To utilize all their inherent capacity the new motor-generators are provided with a control which automatically allows more output as the car speed increases above the rating speed in proportion to that due to the better ventilation of windings. Fig. 1 shows that from 12 to 20 per cent more current can be safely carried at twice the rating speed. A current limit device also permits an additional 25 per cent increase in current on a short-time overload basis.

Commutation

The commutation duty increases in proportion to the speed and current. Ample commutating capacity is provided, such that sparking at maximum speed and maximum current overload is not excessive. The mechanical stresses in the commutator itself are increased at the higher peripheral speeds and currents. This makes it necessary to process commutators by repeated baking cycles until they are smooth and round, under conditions

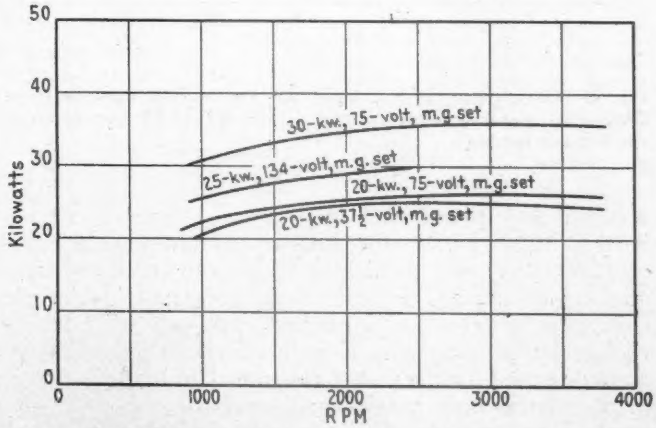


Fig. 1—Continuous kw. ratings versus armature speed for type GMG motor-generator sets

of speed and heat shock that are more severe than would ordinarily occur in service.

The shaft diameter was made ample to keep critical speed above operating speeds. It is relatively large because of the high operating speed and extra length of shaft between bearings required to accommodate both the a.c. rotor and d.c. armature. Every effort is made in the design of the core assembly to prevent the shaft from bending. Any misalignment is reflected in commutator eccentricity which must be held at a minimum for best commutation.

Just a few of the problems and how they were over-

*Motor Division, Locomotive & Car Equipment Divisions, General Electric Company, Erie, Pa.

come in the building of relatively high-speed generators have been discussed to show that in machines designed for higher rotative speeds to obtain lighter-weight generators for a given capacity, more capacity or more speed range for a given weight, the mechanical structure must be much more rugged than on the older slower-speed machines.

Ventilation

Self-ventilated machines which take their cooling air from under the cars are relatively free of dirt at low speeds when the inlet air velocity is low. When operating at high fan speeds, the tendency is to blow out any accuculations of dirt because of the high air velocity through the inside of the generator. The dirt which

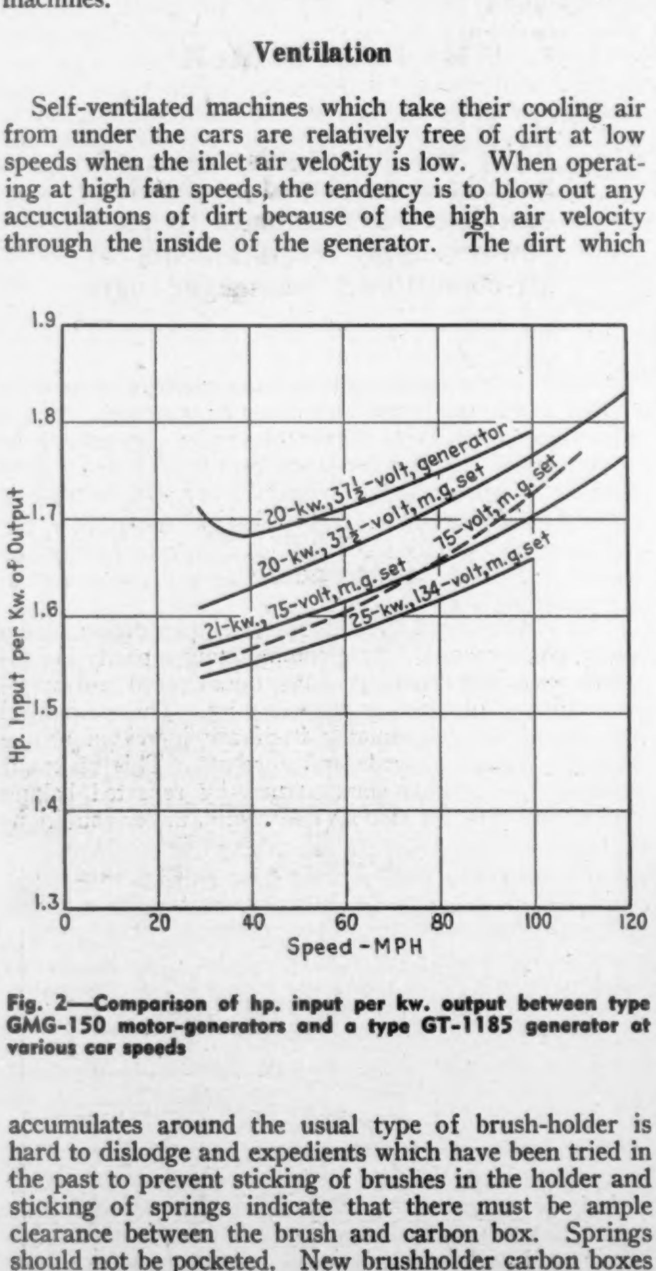


Fig. 2—Comparison of hp. input per kw. output between type GMG-150 motor-generators and a type GT-1185 generator at various car speeds

accumulates around the usual type of brush-holder is hard to dislodge and expedients which have been tried in the past to prevent sticking of brushes in the holder and sticking of springs indicate that there must be ample clearance between the brush and carbon box. Springs should not be pocketed. New brushholder carbon boxes were designed for the motor-generators to hold the brush in position at only a few small areas of contact. The boxes have large cored openings at the sides, back and front of the brush to allow dirt to pass freely.

Self-ventilated generators of earlier design with baffled air inlets, solid-top commutator cover and solid top at the air exhaust end, are being used successfully throughout the year with full ventilation under cars operating in north and south service where they are subjected to extremes of weather. The new motor-generators are provided with the same "all weather" protected air inlets and outlets.

The new 37½-volt and 75-volt generators are designed to cover a speed range of 690 to 3,780 r.p.m. as compared to 690 to 2,470 r.p.m. for the equivalent older-model generator. The increased speed coverage was obtained without any major change in the voltage regulator used in the past. Stability is excellent over the entire range.

Efficiencies

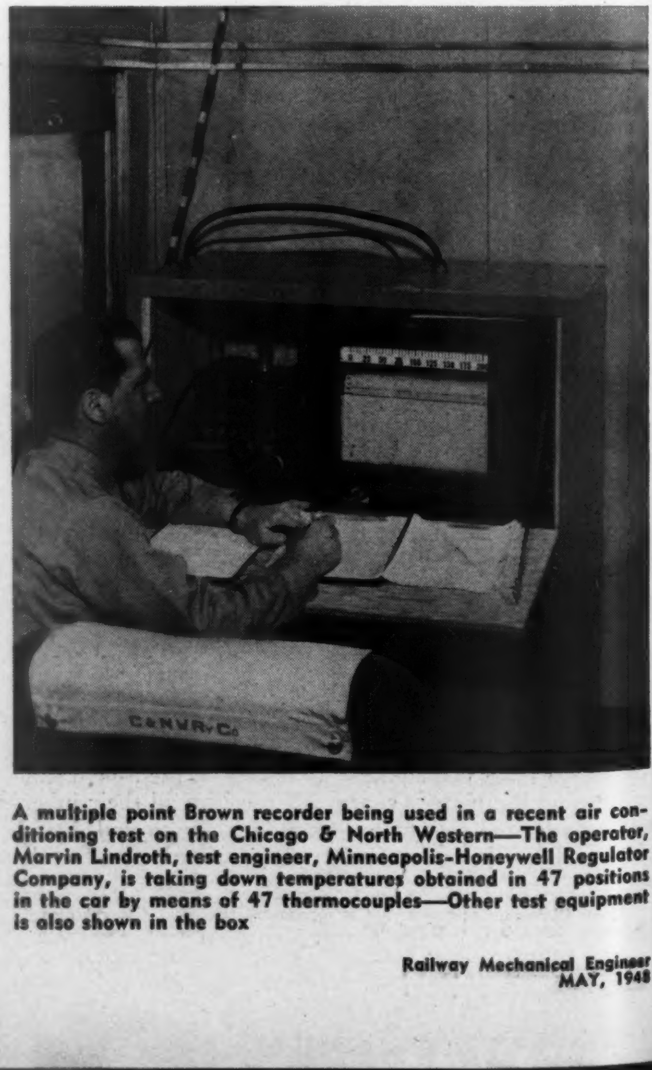
The power required to drive axle generators is supplied by the locomotive and the most efficient type generator is desired. By reference to Fig. 2, it will be seen that the new line of generators all require less horsepower input per kilowatt of output than the old standard generator at their rating. To compare the respective efficiencies of the generators, divide 1.342 by the horsepower input per kilowatt of output as read from the curves. The curves indicate that for the same horsepower input to the generator, the 134-volt machine will give 5 per cent more output than the 37½-volt machine and 2 per cent more output than the 75-volt machine at a speed of 60 m.p.h.

The four designs of motor-generators have different windings, but wherever possible the mechanical parts are the same. Some of the identical parts are frames, bearing housings, bearings, shafts, fans, brushholders, brushholder supports, armature reversing switches, covers and brushes. The advantage of duplicating parts, even though no user may have more than one type of motor-generator, is that less stock is required by the manufacturer readily to provide spare and repair parts.

Proven Features

The new General Electric motor-generator sets have been developed for today's needs on railway cars equipped with electro-mechanical air conditioning and modern illumination. They incorporate features in design which past experience has proved necessary to assure successful operation at the higher speeds and kilowatt loadings.

★ ★ ★



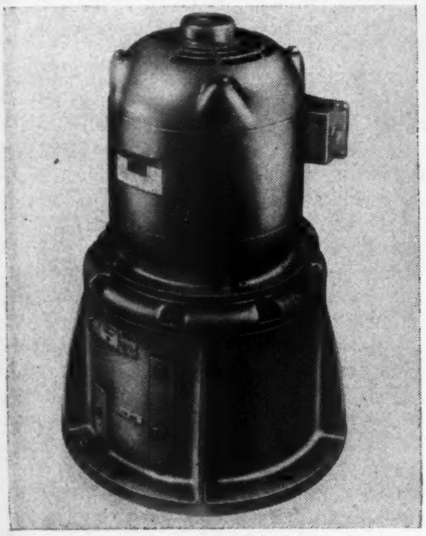
A multiple point Brown recorder being used in a recent air conditioning test on the Chicago & North Western—The operator, Marvin Lindroth, test engineer, Minneapolis-Honeywell Regulator Company, is taking down temperatures obtained in 47 positions in the car by means of 47 thermocouples—Other test equipment is also shown in the box

NEW DEVICES

Vertical Gearmotor

A vertical gearmotor is the latest addition to the Westinghouse gear drive line. Each unit is a self-contained drive, consisting of a high-speed motor and speed reducing unit. Nine different gear ratio combinations are available, ranging from 7.61:1 to 38.9:1.

The gearmotors are available in 3 to 50 hp. ratings, for 220-, 440- or 550-volt,



Vertical gearmotor with open protected motor

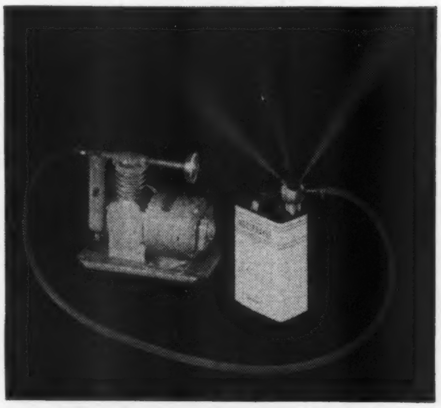
3-phase, a.c. power, and 3 to 7½ hp. ratings for 115- or 230-volt d.c. power. They may be equipped with practically any standard motor in a variety of enclosure types including: open protected, semi- or totally-closed, and explosion proof.

The design of the gear case is such that all gears and bearings receive positive lubrication at all operating speeds. The single helical gears and pinions of 40 to 50 carbon steel are given a "tough-hard" treatment before hobbing.

Passenger Train Sprayer For Insect Extermination

The Indusprayor can fill a space of 50,000 cu. ft. with insect-killing mist in about five minutes using a few ounces of insecticide. Power can be supplied by an installed air or steam system or by a small portable compressor which is driven by an a.c. motor and is connected with the sprayer by a 15-ft. hose. The compressor weighs 37 lb. and produces up to 60-lb. pressure.

Either of two insecticides, Difuso or Induspray, can be used with the Indusprayor. Both are said quickly to kill roaches, waterbugs, flies, ants, lice, bedbugs, fleas, moths, etc., and with no waiting for paralyzed bugs to



The Indusprayor being operated by the portable compressor

die. Neither insecticide leaves any odor or residue. Difuso has a pyrethrum base, and is recommended for use in kitchens and dining cars. Induspray contains lethane and pyrethrum and cannot be used around exposed foods.

The Indusprayor is available, either with or without the compressor, from The Tanglefoot Company, Grand Rapids, Mich.

Quick-Change Spindle

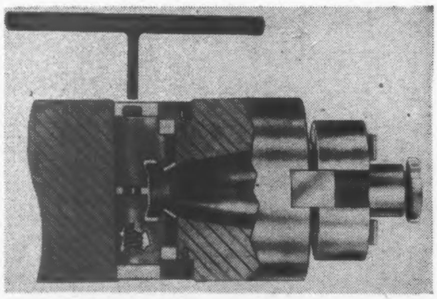
A positive means of seating and ejecting shank-type cutters, arbors and adapters without resorting to draw keys and drifts is now available with the Quick-Change horizontal boring machine spindle made by the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. The spindle is provided with a steep or fast taper socket and a simple built-in double-acting screw locking device.

This spindle improvement enables the machine operator rapidly to

Turning the T-wrench locks the shank in the machine spindle, eliminating the need for hammering

mount cutting tools by merely inserting the shank of the cutter, arbor, adapter or boring bar into the spindle opening, or socket. The latter has a National Standard taper. The double-acting screw lock composed of two segments and screw is located in a special draw slot in the machine spindle immediately behind the taper opening. It is retained in position by hold-down plates bolted into either end of the slot.

Seating or drawing in the shank is accomplished by tightening the lock's single screw which has both right- and left-hand threads. Drawing the two lock parts together by means of a small T-wrench causes a wedging action between the lock segments and against tapered notches cut in the adapter shank. This even distribution of positive locking pressure over the entire surface of the fast taper shank and the mating taper of the spindle socket holds the arbor or



The double-acting screw-and-wedge lock of the Giddings & Lewis quick-change lock—Tightening the screw locks the tool or arbor shank in the spindle

adapter solidly and accurately in place.

To eject the cutting-tool assembly, the lock screw is turned in the opposite direction. A second taper on the lock segment wedges against the mating taper on the end of the arbor or tool shank. Applying pressure with the hand wrench breaks the friction between the contacting surfaces and permits easy removal of the cutter assembly from the machine spindle.

Among the advantages claimed for this means of locking tools in the machine spindle is the elimination of the need for draw keys, soft hammers and drift keys. As no pounding or hammering is necessary to mount the tools, this possible source of damage to the spindle is eliminated. A complete tool change requires approximately 15 seconds. Insofar as no portion of the locking device extends beyond the surface of the spindle, it can be fully retracted into the headstock. With the machine spindle in this position, maximum rigidity is imparted to the cutting tools, thus im-

proving overall quality of the work.

The Quick-Change spindle may be specified on all new G. & L. horizontal boring, drilling and milling machines. It is also adaptable to existing G. & L. machines as well as to machinery of other manufacturers.

Jack With Separate Pump

The Lo-Hite is a hydraulic jack in which the lifting member is a piece separate from the jacking mechanism to permit its use in close quarters for such jobs as renewing locomotive spring pins, shackle pins and wearing pads. The pump can be operated from the ground or any convenient plane while the jack itself is spotted in confined positions that would otherwise be impossible of access.

The lifting portion of the Lo-Hite hydraulic jack can be placed in a confined location and the jacking mechanism operated from a more convenient location

In the Lo-Hite jack the independent pump is connected to the jacking mechanism by a length of rubber tubing. The oil is sealed in and completely isolated from the exterior of the jack, thereby permitting the jack to be used in both vertical and horizontal positions.

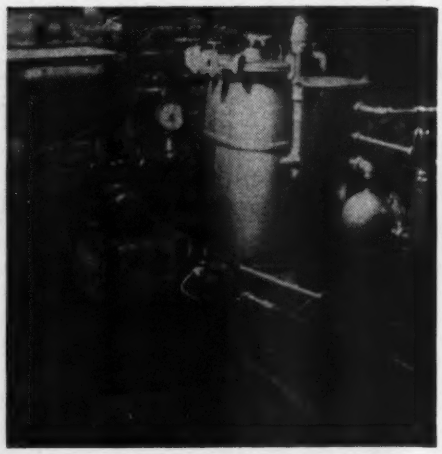
The Lo-Hite hydraulic jack is a product of the Duff-Norton Manufacturing Company, P.O. Box 1889, Pittsburgh 30, Pa.

Water Softener For Use on Diesel Locomotives

The Watermaster is an adaptation of the Servisoft system of domestic water softening for use on Diesel passenger power to increase the flexibility of locomotive assignments. The complete treating unit can be installed on the locomotive to permit the use of any available water supply ranging from water already treated for steam-locomotive consumption to heavily silted or muddy waters. With the water-softening installation, fully de-ionized water is furnished to the steam generator regardless of the condition of the water supply.

The process completely removes the scale-forming carbonates and sulphates, rather than replacing the original salts with different compounds. Fresh minerals are supplied at the beginning of each locomotive trip; at the completion of the run, or when the minerals are exhausted, they are removed to a reclamation plant to be regenerated with soda ash and sulphuric acid for further use. The minerals are contained in porous bags to facilitate replacement.

Watermaster equipment consists of a raw water pump, a diffusion chamber to remove oxygen and carbon-dioxide gases, a heat exchanger unit, a float control and a small tank containing the de-ionizing anion and cation minerals. In the de-ionizing tank the scale-forming compounds are removed from the water by the minerals in the porous bags, which minerals serve also to filter the water in its passage through the tank. As the water leaves the de-ionizing tank it passes through a heat exchange unit and is fogged, together with steam from the separator of the steam generator, into the diffusion chamber. This is a small covered container which has a vent to the atmosphere and a float control. The float control maintains the water at a level that assures a supply of conditioned water for the boiler feed pump at any rate of consumption.



A test assembly of the Watermaster

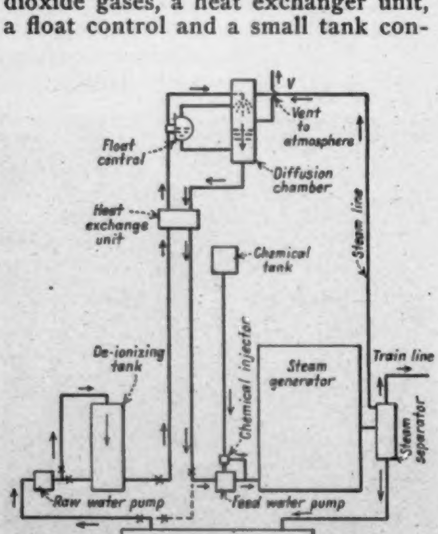


Diagram of the Watermaster system for complete de-ionization of Diesel locomotive steam-generator water supply

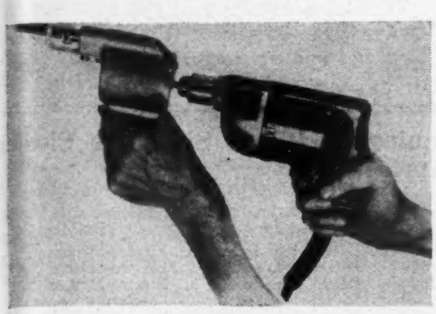
The chemical process of de-ionization occurs in two steps. In the first step the anion mineral changes the carbonates and sulphates into various acids. These acid ions, with the exception of those of carbonic acids, are removed in the second step by the cation mineral. The carbonic acid, being unstable, breaks down in the diffusion chamber into carbon-dioxide gas and water; the carbon-dioxide is vented to the atmosphere, thus leaving only the completely de-ionized water to be transferred by the feed pump from the diffusion chamber to the steam generator. If a slight after treatment is desired this may be introduced in solution form with the small chemical injector furnished with the generator.

The Watermaster is a product of the W. M. Corporation, 608 South Dearborn street, Chicago 5. It has a water-treating capacity of 12 gal. per min. or 720 gal. per hr.

Portable Attachments For Electric Hand Drills

To increase the range of operation of electric hand drills and most drill presses, four interchangeable attachments are produced by the J. D. Whittle Company, 208 N. Wells street, Chicago 6, which will enable the user to sand, drive screws, polish, grind or file, in addition to sawing

wood, steel, plastic and other similar materials, all with the same power unit. These attachments are light enough to be carried from job to job



The saw and file attachment for hand drills converts the drill into a two-handed tool for sewing or filing

and require no special skill for operation.

There are no gears or crankshafts to wear out or to be replaced, and all working parts are case hardened. Where rotary motion is converted to reciprocating motion, the conversion is made by cam action.

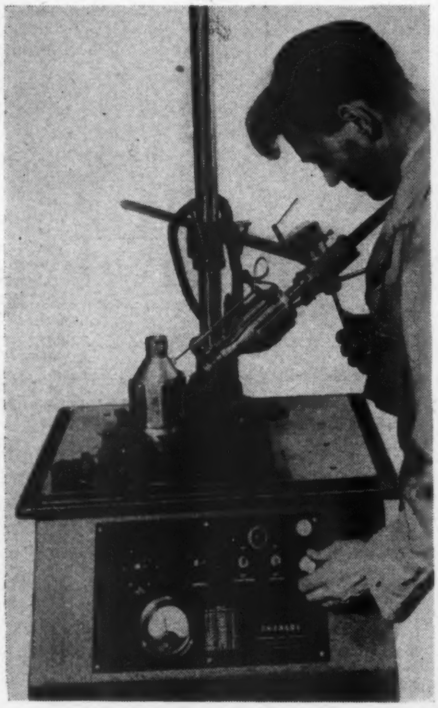
Attachments include a saw and file attachment for hand drills only and a saw and file attachment for either hand drills or most types of drill presses. Both convert the regular spinning motion of the electrical hand drill into forward-backward motion for sawing or filing. For sawing, broken pieces of regular hack saw blades are used; for filing a piece of file with a ¼-in. shaft is inserted. A screw-driver attachment and a 3-in. disk sander, both of which are usable with either electric hand drills or drill presses, complete the list of attachments.

Tap and Drill Disintegrator

An automatic steel disintegrator that removes taps, drills, studs, reamers, etc., from die sections, castings, hardened steel, brass, bronze and almost any alloy without distortion or heating of the casting or the machined part, is manufactured by the Ansaldi Tool & Engineering Co., 4744 Twelfth street, Detroit 8, Mich. Electrodes are used as the vehicle to remove the obstructions and once adjusted in position the disintegrator will complete the operation without further attention. Broken No. 2 taps up to 1 in. in diameter may be removed. An ordinary ½-in. tap is said to be disintegrated in 7 or 8 min. Electrodes, several feet in length, are available for deep holes.

The electrode disintegrates the material in the center of the tap, drill or stud and the walls or threaded part collapses. After the collapsed shell is removed from the hole, it is retapped to clean out any chips which may have been left.

The disintegrator is of the revolving-head type which can be swiveled to any angle or compound angle. It can be used horizontally, upside-down, to a height of 7 ft., or close to the floor. The extended arm has a radius of 4 ft. The standard unit is equipped with casters, for ease of moving about the shop but is also supplied in a model for use on the bench and there is a portable type adaptable to drill-press operation. The tables on the standard machine



The Ansaldi Disintegrator

have ⅜-in. screw holes for positioning holding devices and work pieces.

The disintegrators have an automatic feed and control for twenty-four hour operation without overheating. The control panel is equipped with a voltmeter, control knobs and water valves.

Time Saved in Drilling Boilers

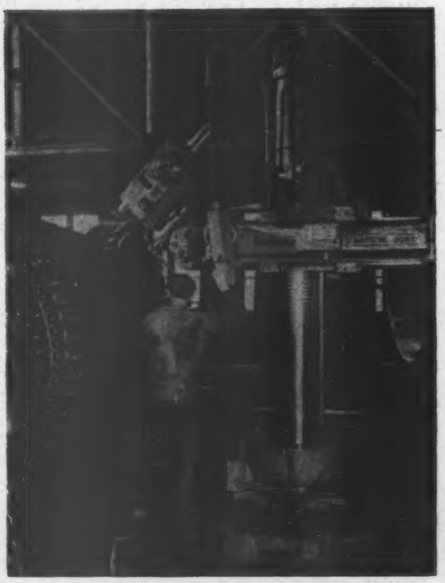
The portable drilling and tapping machine manufactured by the Kaukana Machine Corporation, Kaukana, Wis., which was described in the February issue, is shown here drilling holes in a locomotive steam boiler. There is considerable variation in angularity and alignment of the holes. The sequence of operations consists of drilling check-valve holes in the back boiler head and then moving the machine around to the side of the boiler and drilling the wash-out plug holes. All of these holes are 2¾ in. in diameter.

A comparison of the method previously used with the present one using the portable machine reveals some interesting savings in machining time and man-hours. Formerly, an air-motor-driven drill had to be held in place with an "old man" and the drill advanced into the work with a hand-feed screw. For drilling the relatively large 2¾-in. holes, the job required three men and it took 20 min. to drill each hole; now one operator drills these holes in 4 min. each on the portable drilling and tapping machine. In addition, total setup time has been reduced 60 per cent.

The machine is placed in two positions to reach all holes. The simplicity of moving the machine between setups is demonstrated by the short interval of time needed to make the change. Only 10 min. are required to move the machine from one setup to the other, using the shop crane. This includes positioning the head preparatory to drilling.

One of the major advantages of the machine on this job is that it may be moved and set on an ordinary shop floor and in a fairly confined space. On some types of extra large work, parallels or box plates are used to support the base of the machine and thus increase the vertical range that may be reached with the spindle. The base of the machine is designed either to be bolted to a floor plate or simply set on the floor without anchoring support. Hinged spreader arms on the basce may be swung out and adjusted for floor irregularities to add to the stability of the machine when the base is not bolted to its support.

This portable drilling and tapping machine permits virtually universal spindle alignment and positioning to the workpiece. The head may be rotated in-



Drilling 2¾-in. washout-plug holes with the machine head adjusted to the correct angle

dependently on the supporting trunnion 360 deg., and it may also be swiveled 180 deg.—90 deg. up, and 90 deg. down—in a plane at right angles to the rotation of the head. In addition, the entire head, rail and column rotate 360 deg. as a unit. This permits the machine to be used as a conventional radial drill by simply tilting the head down to bring the spindle in the vertical position. The linear traverse of the column horizontally on its runways increases the lateral range of the machine.

NEWS

A.A.R. to Participate in Air-Conditioning Study

THE board of directors of the Association of American Railroads, at its regular monthly meeting in Washington, D.C., on March 26, voted to participate, with the American Society of Heating and Ventilating Engineers, in a joint research program on air conditioning.

The studies are expected to extend over three or four years. They will cover such subjects as air filters; heat flow through materials; distribution of heated and cooled air, and physiological adjustment to changes in atmospheric environment.

Special Fittings Facilitate Brake Pipe Repairs

IN a circular letter dated February 12, the secretary of the A.A.R Mechanical Division called attention to new Item 100, added to Interchange Rule 101, effective January 1, 1948, which is preceded by a note reading: "Note.—Air Brake Pipe on AB brake equipment, broken at threaded portion of the flange fitting, may be repaired by the use of Wabcogrip or Flexigrip fittings (or other A.A.R. approved types), as correct repairs, charge to be based on material applied, plus labor of application." The letter stated that the use of these fittings should greatly facilitate repairs to broken air brake pipe and suggested more general attention to this ruling.

Gas Turbines for Mobile Power Plants

A COMPACT, easily moved, source of emergency electric power may be made available within the next few years by mobile gas-turbine plants now under development by Allis-Chalmers engineers.

Studies have been made of 3,000- and 6,000-kw. units to be mounted on railway trucks for rapid movement on railway track. The proposed units could operate as a sole source of power or could be synchronized with an existing power system.

Simplicity, smooth operation and no requirement for water would characterize the gas-turbine plants. Operating on oil, the units would require only fuel-line connections to tank cars or storage tanks, in addition to the electric transmission line connection.

McGrath Assistant to General Manager Tool Association

ROBERT H. MCGRATH, formerly vice-president and general manager of Jos. Dyson & Sons, Inc., has been appointed assistant to the general manager of the National Machine Tool Builders' Association.

Orders and Inquiries for New Equipment Placed Since the Closing of the April Issue

Locomotive Orders

Road	No. of locos.	Type of loco.	Builder
Pennsylvania[1]	8	6,000-hp. Diesel-elec. frt.	Electro-Motive
	4	1,000-hp. Diesel-elec. switch.	Electro-Motive
	10	600-hp. Diesel-elec. switch.	Electro-Motive
	6	4,000-hp. Diesel-elec. frt.	Fairbanks-Morse
	12	1,000-hp. Diesel-elec. switch.	Fairbanks-Morse
	27	1,000-hp. Diesel-elec. switch.	Baldwin Loco. Wks.
	27	660-hp. Diesel-elec. switch.	Baldwin Loco. Wks.
	10	1,000-hp. Diesel-elec. switch.	American Loco. Co.
	10	660-hp. Diesel-elec. switch.	American Loco. Co.
Spokane, Portland & Seattle	1[2]	1,500-hp. Diesel-elec. frt.	American Loco. Co.
	2[2]	6,000-hp. Diesel-elec. frt.	American Loco. Co.
	1[2]	2,000-hp. Diesel-elec. frt.	Electro-Motive

Freight-Car Orders

Road	No. of cars	Type of car	Builder
Chesapeake & Ohio	2,000[3]	70-ton hopper	American Car & Fdry.
	1,000[3]	70-ton hopper	Bethlehem Steel
Chicago & North Western	1,000	Box	Pullman-Standard
	650	Hopper	Pullman-Standard
	650	Gondolas	Bethlehem Steel
Chicago, Burlington & Quincy	1,000[4]	50-ton box	Co. shops
	100	50-ton parts cars	Co. shops
	150	70-ton covered hopper	Co. shops
	500	70-ton hopper	Co. shops
	250	70-ton ballast	Co. shops
	500	40-ton stock	Co. shops
	300	50-ton flat	Co. shops
	50	70-ton mill-type gondola	Co. shops
	200	16,000-gal. tank	Co. shops
Carbon County	300	70-ton hopper	Pullman-Standard
Delaware & Hudson	150[5]	40-ton box	Co. shops
	150[5]	50-ton hopper	Co. shops
Illinois Central	200	50-ton box	American Car & Fdry.
Louisville & Nashville[6]	4,000	50-ton twin hopper	Pullman-Standard
Mather Stock Car Co.	150	40-ton refrigerator	Co. shops
Missouri Pacific	55	Caboose	Co. shops
Northern Pacific	500[7]	50-ton box	Co. shops
	200[7]	50-ton flat	Co. shops
Pennsylvania[1]	300	70-ton covered hopper	Co. shops
	2,000	70-ton gondola	Co. shops
St. Louis & O'Fallon	300	50-ton hopper	St. L. Refrig. Car Co.
St. Louis Refrigerator Car Co.	100	40-ton refrigerator	Co. shops
Southern Pacific	3,350[8]	50-ton box	Pullman-Standard
	1,000[8]	50-ton gondola	General-American
	1,000[8]	50-ton gondola	Bethlehem Steel
	700[8]	50-ton gondola	Co. shops
	600[8]	50-ton flat	Co. shops
	1,500[8]	70-ton flat	Co. shops
	350[8]	70-ton covered hopper	Co. shops
	80[8]	Caboose	Co. shops

[1]These orders are a part of a postwar improvement program which involves the expenditure of $149,000,000 for new equipment and $8,000,000 for modernizing passenger cars. To provide for the servicing and repair of Diesel locomotives, new facilities have been, or are being, built, which will ultimately cost $16,500,000 when fully completed. By May of this year the Pennsylvania expects all its important east-west through passenger trains will be handled by Diesel power in the non-electrified territory west of Harrisburg, Pa. The wholly new equipment, together with that being modernized, it is said, will enable the road to release from its most important trains existing lightweight equipment that is still distinctly modern for use on other trains to replace older equipment.

The Pennsylvania also has under way a program for the complete reconstruction and modernization of 100 coaches for use throughout the system. A number of other coaches and parlor cars are being modernized to re-equip several important through trains. As new sleeping, dining, lounge and observation cars now under construction are received from the builders, they will be used to provide entirely new trains for the "Broadway Limited," the "General," the "Liberty Limited," the "Spirit of St. Louis," the "Pittsburgher," the "Golden Triangle," the "Cincinnati Limited," and the "Sunshine Special." The "Senator," afternoon train between Washington, D.C., and Boston, Mass., and the "Congressional," between New York and Washington, will receive completely modernized equipment. A modernized train also will be provided for joint service between Chicago and Detroit, Mich., matching a similar train to be supplied by the Wabash.

[2]The 1,500-hp. unit is scheduled for delivery in January, 1949, the 6,000-hp. engines in March, 1949, and the 2,000-hp. engine next July.

[3]Deliveries to start in December.

[4]It is expected the box cars will be completed in July and that the other cars will be finished at various times during the remainder of the year.

[5]Completion of all the cars is expected during the early part of 1949.

[6]The L. & N. will spend approximately

$55,000 in the near future to convert 30 box cars into cabooses. Work will be done at the South Louisville, Ky., shops. The Timken Roller Bearing Company has received an order for more than 900 large size bearings and parts for all axles of the 22 steam locomotives and tenders being built for the L. & N. by the Lima-Hamilton Corporation as announced in the April issue. Delivery of the bearings and parts are scheduled to begin in August and be completed in October.

[7]Construction of the box cars probably will begin in June and the flat cars probably will be well started in September.

[8]Deliveries of the cars ordered from Pullman-Standard and Bethlehem Steel are scheduled to begin next September and deliveries of the other cars, excluding the cabooses, are expected to begin in the fourth quarter of the year.

Shop Improvements

THE *Chicago, Milwaukee, St. Paul & Pacific,* as part of its 1948 improvement program, will construct a shop at Milwaukee, Wis., for the servicing and repairing of Diesel locomotives.

The *Kentucky & Indiana Terminal* is altering its enginehouse at Louisville, Ky., to provide facilities for the handling of Diesel-electric switchers. The present locomotive pits will be removed, and two pits for serving Diesels, plus a 30-ton crane, will be installed.

The *Lehigh Valley* has broken ground at Sayre, Pa., for facilities for servicing Diesel locomotives. The complete program, involving an expenditure of $240,000, is expected to be completed this year. Five stalls, each accommodating two 2,000-hp. Diesel-electric units, will be housed in the northeast section of the "back shop." Three of the stalls will be equipped with drop tables to facilitate wheel and truck replacement. The shop will be used not only to service the passenger Diesels now in service, but has been planned for the possible purchases of Diesel locomotives for freight service.

Supply Trade Notes

SPRING PACKING CORPORATION.—*W. Hunter Russell,* whose appointment as vice-president of the Spring Packing Corporation, at Chicago, was reported in the April issue, was educated at the University of Illinois, after which he entered the service of the Illinois Central at Chicago. He later was associated with the American Locomotive Company at Cleveland, Ohio. Prior to his appointment as vice-president of the Spring Packing Corporation, Mr. Russell was district manager of the Baldwin Locomotive Works at St. Louis, Mo.

◆

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—*Norman B. Johnson,* assistant executive vice-president of the Pullman-Standard Car Manufacturing Company, at Chicago, has been appointed head of all activities relating to the operation of the Pullman Car Works, the Chicago passenger-car division of the company.

◆

DEARBORN CHEMICAL COMPANY.—*E. J. McMahon,* production manager of the Dearborn Chemical Company at Chicago, has been elected vice-president and a director, with headquarters at Chicago. *Frank A. Jones* has been appointed chief engineer, with headquarters at Chicago, and *Gordon E. MacLean,* who has been engaged during the past seven years in laboratory research for Dearborn, has joined the company's sales department at Indianapolis, Ind.

E. J. McMahon was born on October 20, 1898, at Chicago. He attended Notre Dame University and entered the service of Dearborn Chemical in 1919 as a laboratory chemist. Mr. McMahon worked for a time at the company's branch in Los Angeles, Calif., subsequently returning to Chicago, where he advanced to production manager.

◆

AUTOMATIC TRANSPORTATION COMPANY.—The Automatic Transportation Company, Chicago, has appointed the following sales and service agents: The *George E. Miller Company,* Watertown, Mass., to cover Maine and New Hampshire and five northeastern counties in Massachusetts; *Freeman Industrial Service, Inc.,* Providence, R.I., to cover Rhode Island and five southeastern counties in Massachusetts, and *G. Cass Lightner,* Thetford, Vt., to cover Vermont.

◆

FAFNIR BEARING COMPANY.—*Maurice Stanley,* president of the Fafnir Bearing Company for the last 21 years, has been elected chairman of the board, and *Stanley M. Cooper,* formerly executive vice-president, has been elected president to succeed Mr. Stanley.

Before joining Fafnir as sales manager in 1914, Mr. Stanley was export manager of Russell & Erwin. He is director of the Stanley Works, the New Britain Machine Company, and the Union Manufacturing Company, and vice-president and a director of the Hart & Cooley Co. Mr. Cooper joined Fafnir in 1924 and has been, successively, advertising manager, secretary, vice-president, and executive vice-president.

◆

SHERWIN-WILLIAMS COMPANY.—*Howard C. Hinig,* formerly a member of the transportation sales department of the Sherwin-Williams Company, has been appointed assistant manager of industrial and transportation sales, with headquarters at Oakland, California. Mr. Hinig joined Sherwin-Williams in January, 1936, as a clerk in the traffic department. Two years later he was transferred to transportation sales. He worked in that department until his recent appointment, except for the period July, 1943, to April, 1947, when he was a first lieutenant with the United States Army.

H. C. Hinig

◆

FLANNERY BOLT COMPANY.—*James E. McLean,* vice-president of the Fort Pitt Manufacturing Company, has been

Horsepower Distribution of Diesel Locomotive Units in Service on December 31, 1947—Class I Railroads

	Freight locomotive units		Pass. and comb. pass. and freight locomotive units		Total	
Horsepower	No.	Total hp.	No.	Total hp.	No.	Total hp.
3,000	12	36,000	14	42,000	26	78,000
2,000	23	46,000	678	1,356,000	701	1,402,000
1,800	—	—	36	64,800	36	64,800
1,350 or 1,500	1,799	2,531,100	332	487,650	2,131	3,018,750
1,200	—	—	19	22,800	19	22,800
1,000	45	45,000	28	28,000	73	73,000
Less than 1,000	17	10,660	—	—	17	10,660
Total Road Loco. Units	1,896	2,668,760	1,107	2,001,250	3,003	4,670,010
Switching Loco. Units	(Averaging approx. 830 hp. per unit)				2,916	2,414,910
Total Road and Switching Units					5,919	7,084,920

Note:—629 Diesel locomotive units of 483,260 hp. are estimated to be in service on switching and terminal companies and on Class II and III railroads.

elected also vice-president of the Flannery Belt Company. *R. N. Scott* has been appointed sales manager and *W. C. Masters* manager of railroad sales of Flannery Bolt.

◆

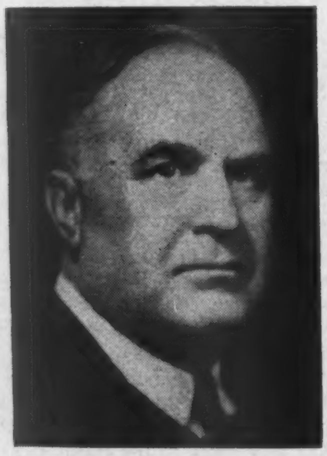
LANDIS TOOL COMPANY.—*The Moore Handley Hardware Company,* 27 South Twentieth street, Birmingham 2, Ala., has been appointed sales distributor in Alabama for the Landis Tool Company. They will handle the Landis line of Precision cylindrical grinding machines.

◆

JOSEPH T. RYERSON & SON.—*Wayne D. Dukette,* formerly manager of the Cincinnati, Ohio, steel service plant of Joseph T. Ryerson & Son, has been appointed manager of the new plant in Emeryville, Calif.

◆

AMERICAN BRAKE SHOE COMPANY.—*William C. Appleby,* assistant to the president of the southern wheel division of the American Brake Shoe Company,



W. C. Appleby

has retired after 42 years' service. Mr. Appleby worked in various engineering and supervisory capacities in American Brake Shoe plants in the south for nearly 23 years. He was transferred to New York in 1929 and was appointed assistant to the president of the southern wheel division in 1944.

◆

AMERICAN CAR & FOUNDRY CO.—*Frederick H. Norton* has been appointed vice-president in charge of all sales of the American Car & Foundry Co., to succeed R. A. Williams, who has resigned.

Mr. Norton is a graduate of Purdue University with a degree in mechanical engineering. He served his apprenticeship with the American Steel Foundries, following which he was assigned to the Chicago office as sales engineer. In 1940 he was transferred to Washington, D.C., to open a new office for the handling of American Steel Foundries' activities with the government and foreign agencies. Mr. Norton joined American Car & Foundry in April, 1945, as an assistant vice-president in the sales department.

The American Car & Foundry Co., has established a new tool and die control division, with *H. O. Amble* in charge. Mr. Amble will make his headquarters at the Berwick, Pa., plant, where he has been mechanical engineer since 1932. *H. F. Schwarting,* formerly general electrical engineer at the St. Louis, Mo., plant, has been appointed assistant district manager of the Madison, Ill., plant.

The company's Washington, D.C., district sales office is now located at 1628 K street, N.W.

◆

DAYTON RUBBER COMPANY.—*T. C. Stikkers,* field engineer of the railway division of the Dayton Rubber Company, has been appointed district sales repre-

T. C. Stikkers

sentative for the central territory, with headquarters at Dayton, Ohio. *L. K. Covelle, Jr.,* also field engineer, railway division, has been appointed district manager for the eastern territory, with headquarters in the Harborside terminal, Jer-

L. K. Covelle, Jr.

sey City, N.J. Mr. Stikkers was with the Pullman Company, Chicago, from 1939 to 1946, in which year he joined Dayton Rubber. Mr. Covelle joined the company on August 1, 1946.

◆

BUCKEYE STEEL CASTINGS COMPANY.—The Buckeye Steel Castings Company has appointed the following sales representatives: *George T. Johnson, Jr.,* in the southeastern district, with headquarters at Columbus, Ohio; *Eugene B. Schrock* in the western district, with headquarters at Chicago, and *Albert T. Johnson* in the eastern district, with headquarters at New York.

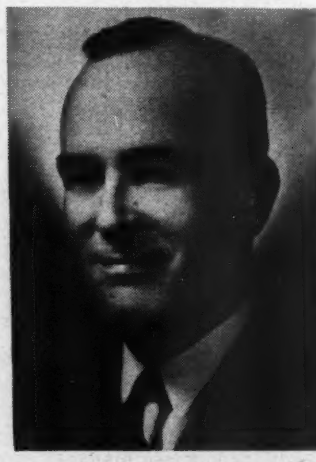
◆

PURDY COMPANY.—*William J. Hammond,* formerly vice-president in charge of railroad sales for the Inland Steel Company, at Chicago, has been elected vice-president of the Purdy Company, with headquarters at Chicago.

◆

PEERLESS EQUIPMENT COMPANY.—*James E. McNamara,* vice-president of the Journal Box Servicing Corporation, at Indianapolis, Ind., has been appointed vice-president — reclamation, of the Peerless Equipment Company, at Chicago.

Mr. McNamara, a native of Indianapolis, attended the University of Notre Dame and, in 1938, joined the staff of service engineers of the Journal Box Servicing Corporation. In 1941 he entered Military Railway Service, subsequently serving in India, Burma and China. For a time he was fuel agent of the 705th Railway Grand Division, and later became aide to the commanding general of railway forces in the India-Burma Theater. He was released from military service as a captain in Decem-



J. E. McNamara

ber, 1945, and returned to the Journal Box Servicing Corporation as service engineer. He was later appointed vice-president. As vice-president of Peerless, Mr. McNamara will concentrate his efforts on contract sales of journal-box waste reclamation and service.

◆

GRIFFIN WHEEL COMPANY.—*Frederick K. Vial,* who has retired as vice-president and a director of the Griffin Wheel Company at Chicago, as noted in the March issue, was born in Lyonsville, Ill., on April 22, 1864. Mr. Vial received degrees in agriculture and natural history in 1886 and a master's degree in civil engineering in 1918 at the University of Illinois. In 1887 he became a rodman in the employ of the Atchison, Topeka & Santa Fe. He was division engineer of the Chicago & Alton (now part of the Gulf, Mobile &

everybody knows the tough guy

To railroad men, the Tough Guy needs no introduction. He's the Chilled Car Wheel, mover of a nation's freight. The job he's doing has become more important in size and more efficient in execution. More rugged, too, with the ever-increasing speeds at which trains are moved today. We at AMCCW have something to do with the way the Tough Guy is keeping pace with his job's taxing demands. For instance, originating, revising and enforcing an ever-stiffening code of manufacturing practice for members . . . testing wheel design for product improvement . . . maintaining our own resident inspectors, general inspectors, supervisory inspection force and metallurgical and engineering staff.

5024

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS
445 NORTH SACRAMENTO BOULEVARD, CHICAGO 12, ILL.

AMCCW

American Car & Foundry Co. • Canadian Car & Foundry Co. • Griffin Wheel Co.
Marshall Car Wheel & Foundry Co. • Maryland Car Wheel Co. • New York Car Wheel Co.
Pullman-Standard Car Mfg. Co. • Southern Wheel (American Brake Shoe Co.)

Ohio) from 1889 to 1892, and chief engineer of the Ajax Forge Company at Chicago during 1895 and 1896. In 1897, Mr. Vial became principal assistant engineer of the Chicago & Western Indiana, and in 1902 mechanical engineer of the Griffin Wheel Company. In 1906 he was appointed chief engineer, in charge of manufacturing operations, cupola mixtures, wheel design, plant construction, and research work. In addition, he was given other responsibilities affecting all plants of the company. Later Mr. Vial was elected vice-president, and in 1917 became a director. Upon the formation of the Association of Manufacturers of Chilled Car Wheels in 1908, he was appointed consulting engineer, and subsequently became also vice-president.

◆

MONARCH MACHINE TOOL COMPANY.—*Fred B. Roth,* formerly supervisor of the service department of the Monarch Machine Tool Company, has been transferred to the west coast as sales and service advisor to a number of dealers who represent Monarch there, with headquarters in San Francisco, Calif. *Clarence J. Caldwell* and *J. A. Garrison,* also former members of the service department, have been appointed field sales engineers with headquarters in Chicago.

◆

LINK BELT COMPANY.—*Arthur E. Maha* has been appointed assistant sales manager for the central division, Ball and Roller Bearing Division of the Link-Belt Company, with headquarters at Indianapolis, Ind. *Lewis M. Watkin, Jr.,* has been appointed assistant sales manager for ball and roller bearings in the eastern division.

◆

BALDWIN LOCOMOTIVE WORKS.—*Eugene S. Wright,* whose promotion to district sales manager for the Baldwin Locomotive Works, at St. Louis, Mo., was announced in the April issue, joined Baldwin's service department for Diesel-electric locomotives shortly after he graduated from Purdue University. He later worked in the sales department in the Chicago district office for two years and was then transferred to Eddystone, Pa. From 1943 to 1946 Mr. Wright was a mechanical engineer with the United States Army Transportation Corps and spent two years in India assigned to the Bengal & Assam Railway. He rejoined Baldwin as assistant to the sales manager of Diesel locomotives and engines and in May, 1947, became sales manager, with headquarters at Eddystone.

◆

BRIDGEPORT-DIAMOND MACHINE COMPANY.—*John T. Kilbride,* who recently resigned as president of the Bridgeport Safety Emery Wheel Company, has been elected president of the newly-organized Bridgeport-Diamond Machine Company. The latter firm has purchased the Diamond Machine Company from the American Engineering Company and has moved the Diamond Machine engineering and sales offices to 2362 Main street, Stratford, Conn.

a unit of POWER

THIS locomotive is a unit of power. It illustrates a significant fact. Where the amount of power that can be packed into a single unit is important—where you want 6000, 8000, even 10,000 horsepower in one engine—the steam locomotive is unchallenged.

We build such locomotives—steam locomotives like this that have developed 8000 horsepower and can do more. We will continue to do so. They are fine pieces of machinery. Modern in every respect, they are establishing remarkable records for economy, reliability and low maintenance.

Don't sell these steam giants short. They have their place—and in their place are unsurpassed.

LIMA HAMILTON CORPORATION

DIVISIONS: ***Lima, Ohio***—Lima Locomotive Works Division; Lima Shovel and Crane Division. ***Hamilton, Ohio***—Hooven, Owens, Rentschler Co.; Niles Tool Works Co.

PRINCIPAL PRODUCTS: Locomotives, Cranes and shovels; Niles heavy machine tools; Hamilton diesel and steam engines; Hamilton heavy metal stamping presses; Hamilton-Kruse automatic can-making machinery; Special heavy machinery; Heavy iron castings; Weldments.

Bridgeport-Diamond Machine is organized to manufacture face grinders, vertical surface grinders and knife grinders. Manufacturing facilities to handle assembly and manufacturing are expected to be in operation within a few months.

◆

TEXAS COMPANY. — *J. M. P. McCraven* has been appointed manager of the railway traffic and sales department of the Texas Company, with headquarters at New York, to succeed the late J. L. Lavalle. Mr. McCraven joined the Texas Company at Houston, Tex., in 1916, and worked successively as chief accountant, assistant district manager, district manager and assistant manager at Chicago.

J. M. P. McCraven

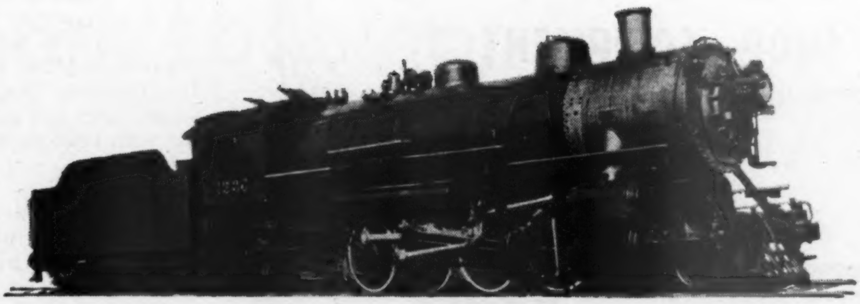
◆

STANDARD RAILWAY EQUIPMENT MANUFACTURING COMPANY.—*R. A. Williams,* formerly vice-president in charge of sales of the American Car & Foundry Co., with headquarters at New York, has been elected president and a director of the Standard Railway Equipment Manufacturing Company, with headquarters at Chicago. Mr. Williams succeeds *A. A. Frank,* who has been elected chairman of the firm's board of directors. *A. A. Helwig,* president of the Standard Railway Equipment Company, subsidiary of the aforementioned company, has been elected also vice-chairman of the board of the Standard Railway Equipment Manufacturing Company.

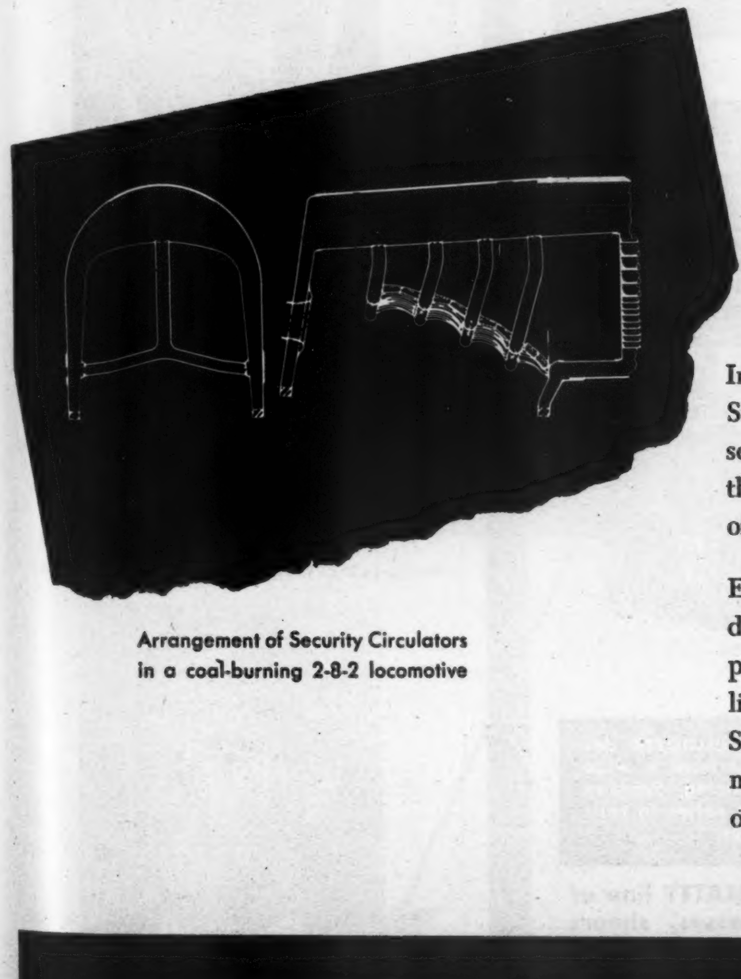
Mr. Williams is a graduate of Pennsylvania State College and Washington University. He joined A. C. F. in 1924 in the engineering department and subsequently became sales manager of district offices in St. Louis, Mo., Cleveland, Ohio, and Washington, D.C. In 1944 he was elected vice-president in charge of sales. Mr. Williams is a member of the American Society of Mechanical Engineers.

◆

ALUMINUM COMPANY OF AMERICA.—The new sheet and plate rolling mill of the Aluminum Company of America at Davenport, Iowa, is nearing completion. The plant, which extends nearly a mile along the banks of the Mississippi river, is basically an all-aluminum project, with the exception of 25,000 tons of structural steel framework which is painted



Security Circulators used in modernizing type 2-8-2 locomotives



Arrangement of Security Circulators in a coal-burning 2-8-2 locomotive

In equipping existing steam motive power with Security Circulators, most efficient results are secured because the number and arrangement of the Circulators are specifically adapted to the type of locomotive in which they are being installed.

Experience has shown that Security Circulators definitely tend to reduce honeycombing, flue plugging and cinder cutting, and to prolong the life of arch brick. Consequently the installation of Security Circulators in existing steam locomotives makes them available for much longer periods of *continuous operation.*

AMERICAN ARCH COMPANY, INC.

NEW YORK • CHICAGO

SECURITY CIRCULATOR DIVISION

with more than three carloads of aluminum paint.

◆

INTERCHEMICAL CORPORATION.—*Albert J. Capalbo,* formerly chief chemist for the Plasticote Fabrics Corporation, has joined the flexible plastic coatings department of the finishes division of the Interchemical Corporation, to serve in both a sales and technical service capacity, with headquarters at Elizabeth, N.J.

◆

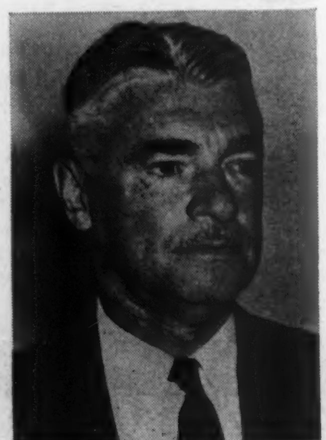
KOPPERS COMPANY.—*E. J. McGehee,* a vice-president of the Koppers Company, has been assigned responsibility for the company's wood-preserving activities throughout the western half of the United States.

Mr. McGehee, who has been staff sales manager, with headquarters in

E. J. McGehee

Pittsburgh, Pa., will now make his headquarters in Chicago. He first became associated with Koppers organization in 1934 and since then has served in various executive positions in connection with the company's production and sale of pressure-treated timber for railroad and utility work.

H. R. Condon, vice-president in the wood-preserving division, has been as-



H. R. Condon

signed responsibility for wood-preserving activities in the eastern half of the country, with headquarters as before at Pittsburgh. Since joining Koppers in

1939 Mr. Condon has served in an administrative capacity in various phases of the production, sales and procurement of forest products.

◆

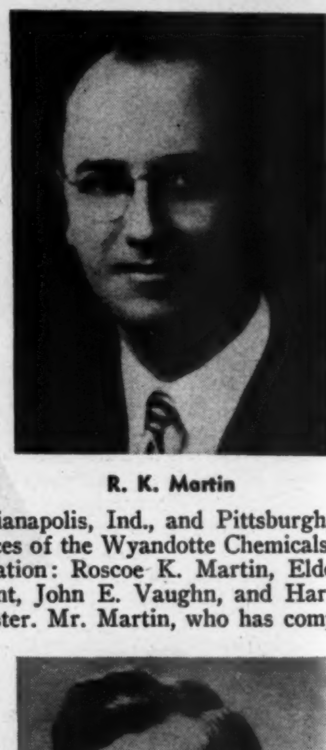
McKay Company. — The Johnson Welding Equipment Company has been appointed Chicago district distributors of the McKay electrodes, with headquarters at 2640 W. Van Buren street, Chicago 12.

◆

Aro Equipment Corporation.— *Walter C. Leitch*, formerly general sales manager of the Gilbert & Barker Manufacturing Co., a subsidiary of the Standard Oil Company of New Jersey, has been elected vice-president and general manager of the Aro Equipment Corporation.

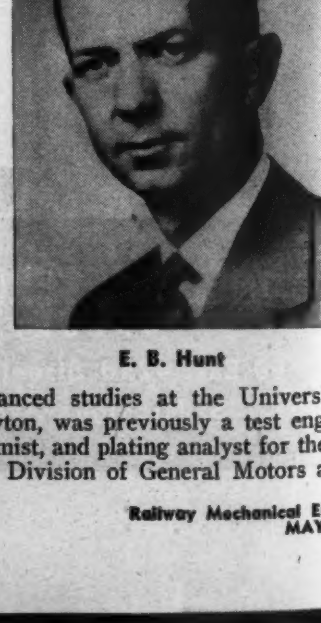
◆

Wyandotte Chemicals Corporation. — The following have been appointed industrial department service representatives in, respectively, the Cincinnati, Ohio; Grand Rapids, Mich.;



R. K. Martin

Indianapolis, Ind., and Pittsburgh, Pa., offices of the Wyandotte Chemicals Corporation: Roscoe K. Martin, Eldon B. Hunt, John E. Vaughn, and Harry L. Flister. Mr. Martin, who has completed



E. B. Hunt

advanced studies at the University of Dayton, was previously a test engineer, chemist, and plating analyst for the Allison Division of General Motors and at

Wright Field. Mr. Hunt is a graduate in chemical engineering of Michigan State College. He has done experimental work in heat treating for Oldsmobile and in electronics for the Navy. Mr. Vaughn, a graduate in chemical engineering of the University of Kansas, has

J. E. Vaughn

been a development engineer for the United States Rubber Company, and an inspection officer for the Navy. Mr. Flister, a graduate of the University of

H. L. Flister

Pittsburgh, was in the employ of the United States Steel Corporation following active service with the Navy.

◆

YALE & TOWNE MANUFACTURING CO.—The Yale & Towne Manufacturing Co., Philadelphia, Pa., has unified all sales and service facilities in behalf of its electric truck, handlift truck and dial scale divisions at the Railway Exchange building, 80 E. Jackson boulevard, Chicago 4, under *Arthur H. Dobler*, regional manager. *S. A. March* will continue in advisory and consulting capacities. The specialized services for the railroad field, long prosecuted independently by *Earl Thulin* in Chicago, will continue to be separately handled.

◆

WESTINGHOUSE ELECTRIC CORPORATION.—*Charles H. Weaver* has been appointed industrial manager and *Quincy M. Crater*, transportation manager of the Westinghouse Electric Corporation, each responsible for central district sales

Because it

LASTS LONGER

NAILABLE STEEL FLOORING for boxcar use is ribbed to minimize the weight of steel needed for high resistance to surface deflection. Channels are coated with a tough, non-spalling composition that fills the rib depressions providing a level, skid-resistant surface.

*NAILABLE STEEL FLOORING

Cuts Railway Operating Costs... Relieves Shippers' Car Supply Problems

How often must shippers kick cars out empty because the floors aren't good enough for the particular outbound lading? How much time and money is spent switching boxcars—to spot them for loading according to the floor condition? The answers are *too often* and *too much*—because wood floors in most cars soon become damaged and car classifications must be reduced. Then cars must be shunted around empty until a load is available for which the floor is suited. This extra switching of Class B cars and rough-freighters not only cuts into shippers' car supply—it raises railway operating costs.

NAILABLE STEEL FLOORING eliminates much of this extra switching because it stays in Class A condition *longer*. It isn't damaged by nailing, pinch bars, abrasive freight or loading equipment. It has the strength to support the largest fork trucks used in boxcars. NAILABLE STEEL FLOORING is built to last as long as the car itself and stay in Class A condition during that time. Here is an all-purpose floor that *stays* that way, that can make major savings in operating expenses and provide substantial relief for car supply problems.

*PATENTS PENDING

YOU SAVE 3 WAYS

In boxcars, flats and gondolas, the long life of NAILABLE STEEL FLOORING means lower repair and replacement costs as well as lower operating costs. And because it holds nails tighter and won't splinter, goods are safer on NAILABLE STEEL FLOORING. It saves you money in three ways—in operations, maintenance, and damage claims.

NAILABLE STEEL FLOORING

A GREAT LAKES STEEL PRODUCT

GREAT LAKES STEEL CORPORATION

STEEL FLOOR DIVISION, PENOBSCOT BLDG., DETROIT 26, MICHIGAN

UNIT OF NATIONAL STEEL CORPORATION

activities in his respective field.

Mr. Weaver, formerly marine and aviation sales manager at the company's East Pittsburgh, Pa., works, joined the Westinghouse graduate student course in 1936. After four years in the general sales department he was transferred to the marine section of the industrial department. In 1943 he was appointed

C. H. Weaver

manager of the newly formed marine department.

Mr. Crater joined Westinghouse in 1927 as an office assistant in the engineering department at Pittsburgh. He later served in various sales capacities at Chicago, St. Louis, Mo., and South

Q. M. Crater

Philadelphia, Pa., before returning to East Pittsburgh in 1938, as manager of the petroleum and chemical section. He was appointed assistant manager of the Detroit, Mich., office in 1944.

◆

OTTO A. KUHLER, design engineer of the American Car & Foundry Co., has resigned. Mr. Kuhler will resume acting as consultant designer to the railroads, with headquarters at Pine, Colo.

◆

CHERRY RIVET COMPANY.—The Cherry Rivet Company, Los Angeles, Calif., has opened a Chicago branch office at 5707 West Roosevelt road, Cicero, Ill. *Roy Schwab,* formerly a sales representative for the company in the Chicago area, will head the newly organized office staff and salesmen.

ARTHUR CRANE LEWIS, former vice-president in charge of sales for Templeton, Kenly & Co., died at Toronto, Ont., on February 23. Mr. Lewis was 62 years old.

Personal Mention

General

J. E. KERWIN, general foreman of the Chicago, Rock Island & Pacific, with headquarters at Blue Island, Ill., has been appointed assistant to the general superintendent of motive power, at Chicago, with jurisdiction over all mechanical matters.

E. H. TALBERT, traveling fireman of the Chespeake & Ohio, has been appointed chief motive-power inspector, with headquarters at Hinton, W. Va.

J. P. BECKER, assistant to superintendent motive power of the Chicago Great Western at Oelwein, Iowa, has been appointed general mechanical inspector, with headquarters at Oelwein. The position of assistant to superintendent motive power has been abolished.

Diesel

A. L. PORTER, supervisor internal combustion locomotives of the Chicago Great Western at Oelwein, Iowa, has been appointed general supervisor Diesel locomotives, with headquarters at Oelwein. The position of supervisor internal combustion locomotives has been abolished.

W. L. CASTLEMAN, assistant supervisor internal combustion locomotives of the Chicago Great Western at Oelwein, Iowa, has been appointed assistant general supervisor Diesel locomotives, with headquarters at Oelwein. Mr. Castleman's former position has been abolished.

R. S. ASH has been appointed Diesel locomotive inspector of the New York Central System, with headquarters at New York.

H. E. PAPCKE has been appointed Diesel locomotive inspector of the New York Central System, with headquarters at New York.

C. E. RHODES has been appointed Diesel locomotive inspector of the New York Central System, with headquarters at New York.

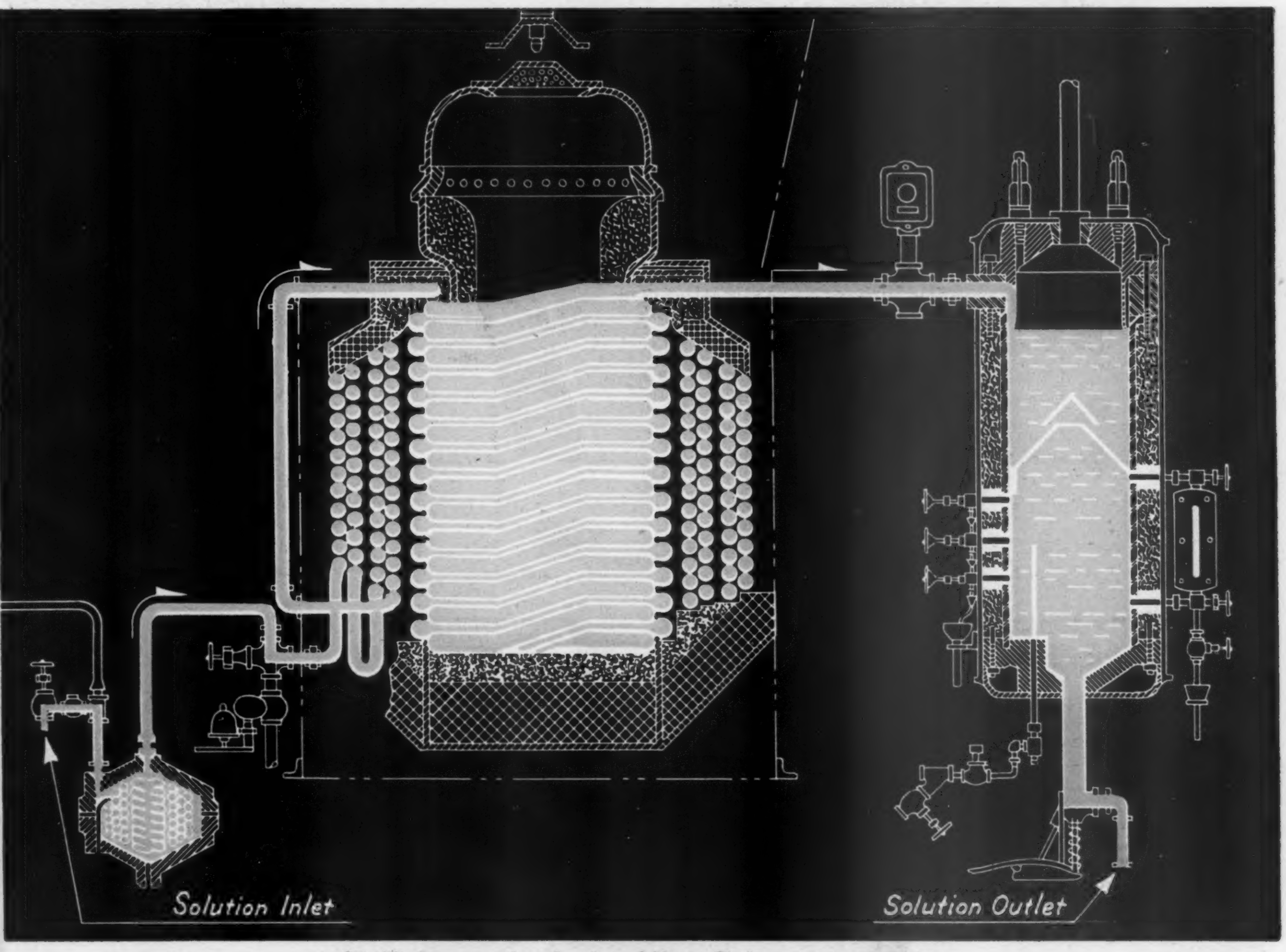
M. H. POWERS has been appointed Diesel locomotive inspector of the New York Central System, with headquarters at New York.

Car Department

JAMES E. DEFREEST has been appointed division general car foreman of the New York Central system, with headquarters at Albany, N. Y.

M. J. MILLS, general car inspector of the Chesapeake & Ohio at Wyoming, Mich., has been appointed assistant

IDEAS FOR DIESEL MAINTENANCE



Simplified cross-section drawing of Vapor-Clarkson steam generating unit, Type CFK 4225, showing flow of Pennsalt PM-90 during washout.

Keep your Vapor-Clarksons at peak efficiency with fast, economical Pennsalt descaling

Here's how more and more Diesel maintenance men are keeping their Vapor-Clarkson boilers free from scale and in peak operating condition. They use the Pennsalt system for descaling . . . built around Pennsalt PM-90 descaling compound.

Pennsalt PM-90 is a specialty acid cleaner designed to give quick descaling with maximum protection to the base metal. Several years of research and testing went into the development of this superior product.

You'll find the Pennsalt descaling system is fast, safe . . . and economical. That's because Pennsalt is a basic producer and carefully controls the manufacture of the ingredients that go into PM-90. Thus quality and uniformity are safeguarded . . . and cost held to a minimum.

Pennsalt's experienced technical staff is ready to serve you. Just write to Special Chemicals Division, Pennsylvania Salt Manufacturing Company, 1000 Widener Building, Philadelphia 7, Pa.

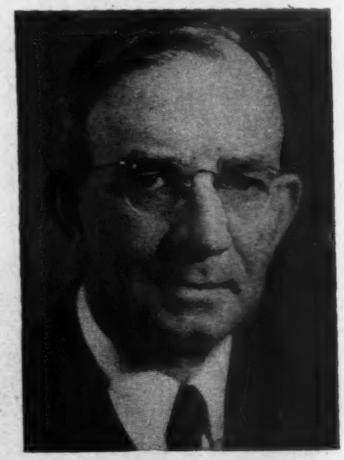
PENN SALT

RAILROAD MAINTENANCE CLEANERS

superintendent of car department, with headquarters at Grand Rapids, Mich.

ARTHUR H. KEYS, assistant superintendent of the car department of the Baltimore & Ohio at Baltimore, Md., has been appointed superintendent car department.

FRANK H. BECHERER, superintendent car department of the Baltimore & Ohio at Baltimore, Md., has retired from active duty, after 47 years of railroad service. Mr. Becherer, began his career in 1901 in the car department of the Erie. He advanced to chief clerk in the car department in 1904 and then entered the car department of the Pennsylvania in 1907. In 1918 he became senior mechanical engineer of the Bureau of Valuation of the Interstate Commerce Commission. He resigned from the I.C.C. in 1922 to go with the Boston & Maine in the mechanical department.



F. H. Becherer

In 1926 he became superintendent of the Car department of the Central of New Jersey and in 1930 assistant superintendent of motive power and equipment. In January, 1942, Mr. Becherer was appointed superintendent of the car department of the Baltimore & Ohio at Baltimore.

Master Mechanics and Road Foremen

J. H. MULLINIX, master mechanic of the Chicago, Rock Island & Pacific at Goodland, Kan., has been transferred to the position of master mechanic at Silvis, Ill.

JESSE P. WALKER, formerly general foreman of the Louisville & Nashville, at Sibert, Ky., has been appointed to the newly created position of assistant master mechanic, at Boyles, Ala.

R. R. MCKINNEY, master mechanic of the Williamsport and Wilkes-Barre divisions of the Pennsylvania, with headquarters at Renovo, Pa., has been transferred to the Philadelphia division, with headquarters at Harrisburg, Pa.

J. G. DANNEBERG, master mechanic, Eastern Lines, of the Atchison, Topeka & Santa Fe at Argentine, Kan., has been

transferred to the position of master mechanic of the Gulf, Colorado & Santa Fe at Temple, Tex.

S. E. Mueller, master mechanic of the Chicago, Rock Island & Pacific at Silvis, Ill., has been transferred to the position of master mechanic at Cedar Rapids, Iowa.

W. F. Kline, road foreman of equipment of the Chicago, Rock Island & Pacific at Fairbury, Neb., has been appointed master mechanic with headquarters at Goodland, Kan.

G. C. Ridens has been appointed road foreman of engines, Memphis division, of the Missouri Pacific, with headquarters at Wynne, Ark.

D. J. Everett, master mechanic of the Gulf, Colorado & Santa Fe (part of the Atchison, Topeka & Santa Fe), at Temple, Tex., has been transferred to Argentine, Kan., on the Santa Fe's Eastern Lines.

L. B. Close, general foreman of the Chicago, Rock Island & Pacific at El Reno, Okla., has been appointed master mechanic at Little Rock, Ark.

C. E. Farley, master mechanic of the Chicago, Rock Island & Pacific at Cedar Rapids, Iowa, has retired after 49 years of service with the Rock Island.

R. E. Detrick, master mechanic of the Chicago, Rock Island & Pacific at Little Rock, Ark., has been transferred to Fort Worth, Tex.

R. Logeman, master mechanic of the Chicago Great Western at Oelwein, Iowa, has had his duties extended to include jurisdiction of the locomotive back shop.

Charles Newton Wiggins, Jr., who has been appointed general master mechanic of the Louisville & Nashville at Louisville, Ky., as noted in the February issue, was born on October 29, 1914,

C. N. Wiggins, Jr.

at Shelbyville, Tenn. He received the degree of mechanical engineer at Mississippi State College in 1939 and on September 7 of the same year entered the South Louisville, Ky., shops of the L. & N. as a special apprentice. He became a machinist on September 21,

1942; assistant general foreman on July 16, 1943; assistant general foreman at Corbin, Ky., on February 16, 1945, and general foreman at Corbin on May 16, 1945. Mr. Wiggins was appointed assistant general master mechanic at Louisville on April 1, 1947, and general master mechanic on January 1, 1948.

Archie Graham Waldrupe, who has been appointed master mechanic of the Southern at Macon, Ga., as announced in the April issue, was born on June 18, 1902, at Robbins, Tenn. He attended the public schools of Oakdale, Tenn., from 1908 until 1918, and on April 9, 1918, became a hostler's helper in the employ of the Southern at Oakdale. He became a machinist helper on November 10, 1918, and a machinist apprentice at Somerset, Ky., on May 7, 1923. From June 10, 1926, to October 18, 1939, he served, successively, as a machinist at Danville, Ky.; Chattanooga, Tenn.; Danville; East

A. G. Waldrupe

St. Louis, Ill.; Danville; East St. Louis; Somerset; Knoxville, Tenn.; Spencer, N.C., and Knoxville. He was appointed assistant foreman roundhouse, John Sevier and Coster Terminal, on October 19, 1939; shop superintendent at Knoxville on October 16, 1941; master mechanic at Bristol, Va., on June 16, 1945, and master mechanic at Macon on January 1, 1947.

Shop and Enginehouse

Edwin B. Connerat, assistant foreman enginehouse of the Southern at Monroe, Va., has been promoted to the position of general foreman at Lynchburg, Va.

J. E. Page, enginehouse foreman of the Atlantic Coast Line at Waycross, Ga., has been appointed general foreman at Waycross.

W. C. Cade, general shop foreman, locomotive back shop, of the Chicago Great Western at Oelwein, Iowa, has retired.

E. M. Scherch, master mechanic of the Baltimore & Ohio at the Cincinnati Union Terminal, Cincinnati, Ohio, has been appointed superintendent of shops, with headquarters at Cumberland, Md.

bringing battery inspection

OUT IN THE OPEN

easy to roll out

One tug at the new EDISON-developed roll-out battery cradle and much of your former battery servicing trouble rolls away! The cradle, gliding on ball-bearing wheels along hinged extension tracks, brings the entire battery "out from under" as a unit — completely accessible for rapid and positive inspection. watering, cleaning.

Besides improved servicing, these advantages are realized:

Better ventilation: battery is suspended above the compartment floor.

Cleaner compartments: easy to remove dust and dirt during servicing.

Quicker shopping: entire cradle removable by crane or fork truck.

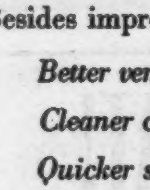
Shorter jumpers: reduced cable footage and maintenance, less voltage drop.

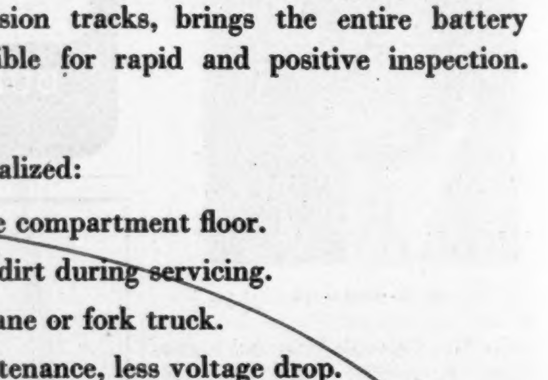
No conflicts: roll-out compartment also accepts conventional assemblies.

No limits: cradle will handle bulkiest assembly now held by customary box.

Don't overlook this new way to cut maintenance costs. Let us assist you in adapting roll-out cradles to existing or proposed compartments. Complete information and typical layouts furnished on request by any of our district offices.

the wheels do the work





EDISON
Nickel • Iron • Alkaline
STORAGE BATTERIES

EDISON STORAGE BATTERY DIVISION OF THOMAS A. EDISON, INCORPORATED, WEST ORANGE, N. J.